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**Soft Energy Paths in Japan:
The Backcasting Approach to Energy Planning**

by

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**A report submitted in partial fulfillment of the requirements for
the PhD**

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Abstract

Climate change is increasingly recognised as a serious threat to the global ecosystem. The international framework, such as the United Nations Framework Convention for Climate Change provides a main mechanism to harness world-wide commitment for greenhouse gas (GHG) emission reduction, to cope with the climate change. Japan is one of the countries which are required to reduce significant amounts of GHG emissions, including CO₂. The Japanese energy policy is rather fragmented and ineffective in coping with the global climate challenge, and often highly controversial options have been included. Nuclear is, for example, considered by the Japanese government as one of the most important elements to meet its obligation, although there are many doubts over the legitimacy of the option in the light of sustainable development.

Against this background, it is critical to review the current energy policy and policy making processes in Japan. This study takes the challenge to propose alternative future visions and to examine their implications in the real policy context. Backcasting methodology, that creates a normative vision and identifies policy path to reach the vision, is identified as a highly relevant conceptual framework to this study. A strategic perspective is applied to the analysis, and the core research quest includes whether the strategic level of discussion between different parties could reduce the policy conflicts and divisions.

The study offered four visions and the subsequent policy packages. The detailed policy paths are created to achieve the visions. Two tier evaluation stages are set to validate the policy packages and paths, through communication with selected Japanese energy experts. The study provides an insight as to the effectiveness of the methodology, and the legitimacy of the proposed visions and policy packages. Series of recommendation are made in terms of methodological and policy perspective. In particular, a “policy road map” is proposed as an effective tool to present policy coordination that enables cross strategic and time based policy analysis.

List of Acronyms

ABWR	Advanced boiling water reactor
ANRE	Agency for Natural Resources and Energy
BAU	Business as usual scenario
BWR	Boiling water reactor
CASA	Citizen's Alliance for Saving the Atmosphere and the Earth
CCGT	Combined cycle gas turbine
CDM	Clean Development mechanism
CH ₄	Methane
CHP	Combined heat and power
CNIC	The Citizen's Nuclear Information Centre
CO ₂	Carbon dioxide
COP	Conference of parties (of United Nations Framework Convention of Climate Change)
CPAESA	Coal and Petroleum/non-petroleum Alternative Energy Special Account
CSA	Coal Special Account
DOE	Department of Energy (US)
DSM	Demand side management
EEA	European Environment Agency
EIA	Environmental impact assessment
EPDC	Electric Power Development Co., Ltd.
EPRDSA	Electric Power Resources Development Special Account
ESCO	Energy Service Company
EU	European Union
EUSBs	Electricity utility Supply Businesses
FBR	Fast breeder reactor
GDP	Gross domestic product
GHG	Greenhouse gas
GNP	Gross national product
HFC	Hydro fluorocarbons
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IPPs	Independent power producers
JI	Joint Implementation
JNEC	Japan Natural Energy Company
kWh	kilo watt hour
LED	Light emitting diodes
LNG	liquid natural gas
LPG	liquid petroleum gas
LTEF	The Long-term Energy Supply-Demand Forecast
LWR	Light water reactor

METI	Ministry of Economy, Trade and Industry (Japan)
MGT	Micro gas turbine
MILT	Ministry of Land, Infrastructure and Transport (Japan)
MoE	Ministry of the Environment (Japan)
MOX	Mixed oxide (fuel)
MW	Mega watt
MWh	Mega watt hour
NEDO	The New Energy and Industrial Technology Development Organisation
NGO	Non government organization
NOx	Nitrogen oxides
N2O	Nitrous Oxide
ODA	Overseas development aid
OECD	Organisation for Economic Cooperation and Development
PFC	Perfluorocarbons
PPAESA	Petroleum/Petroleum Alternative Energy Special Account
ppm	Parts per million
ppmv	Parts per million in gaseous concentration
ppp	purchasing power parities
PPS	Power producer and supplier
PRTR	Pollutant transfer and release registers
R&D	Research and development
RES	Renewable energy sources
RES-E	Renewable sources electricity
RITE	The Research Institute of Innovative Technology for the Earth
RPS	Renewable portfolio standard
SEA	Strategic environmental assessment
SF6	Sulfur Hexafluoride
SO2	Sulfur dioxide
SRES	(IPCC) The Special Report on Emission Scenarios
SS	Strong sustainability
TEPCO	Tokyo Electric Company
TGC	Tradable electricity certificate
TJI	The Japan Initiative
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
VSS	Very strong sustainability
VWS	Very weak sustainability
WCED	World Commission on Environment and Development
WS	Weak sustainability
WWF	World Wildlife Fund
WWII	The World War II

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Chapter 1: SOFT ENERGY PATHS AND JAPAN

“Nuclear issues cannot be considered in isolation from a complex tangle of broader issues of energy and social policy, any more than automobiles can be considered in isolation from the wider patterns and values of human settlements and mobility. To do so would be a common but serious error. The most important and difficult questions of energy policy are not primarily technical or economic but rather social and ethical, and cannot be properly framed by people whose vision is purely technical.” (Lovins, 1975)

1.1 Introduction: Context and Aims

Energy is defined as “the ability or capacity to do work, with *work* defined in its broadest sense of to do or perform something” (Odum, 1993). Energy is essential for both organic and inorganic mechanisms, as “it is the flow of energy that drives the cycles of materials” (*Ibid.*). It is also increasingly recognised that the modern “environmental problems” largely originated from the human energy utilisation to the extent that global energetics and material cycles are considerably disturbed, by direct discharge of energy, or discharge of materials through energy production

processes.

The larger the scale of these human disturbances, the larger the seriousness of their environmental impacts. Nuclear fission, by far one of the most powerful energy production methods, is posing a profound threat to humans, mainly through its ability to produce highly toxic substances¹.

Many countries, however, are currently either planning or constructing new nuclear power stations. Asian countries, in particular, provide examples of those which are pursuing the nuclear possibility, against the background of the region's significant increase in energy demand: its commercial energy consumption was 122,438 peta-joules in 1995, accounting for over 30 per cent of the world requirement (IEA, 1999). There are about 50 nuclear power stations either under discussion or construction in Asia, suggesting that over half of the world new nuclear developments will be concentrated in the region (Japan Nuclear Industry Forum, 1998).

¹ There are plenty of documents describing the dangers of nuclear development. Willrich and Lester (1977) provides a good example with a balanced information about the radioactive materials made through nuclear fission.

Table 1. 1: World and Asian nuclear development (number of installations)

	In operation	Under construction or planned	Total
World	422	92	514
Asia total	86	51	137
Japan	51	6	57
Korea	14	6	20
Taiwan	6	2	8
China	3	12	15
India	10	16	26
Pakistan	1	1	2
Iran	0	6	6
North Korea	0	2	2
Asia total/World	20.3%	55.4%	26.7%

(Source: Japan Nuclear Industry Forum, 1998)

Japan is one of the Asian countries which requires significant amounts of energy, and is increasing its dependence on nuclear energy. Nuclear is, for example, considered by the Japanese government as one of the most important elements to meet its pledge made at the Kyoto Conference, to reduce prescribed greenhouse gas (GHG) emissions (such as CO₂) to the 1990 level by the first commitment period (between 2008 and 2012). According to the government's plan, over 20 nuclear power stations are going to be built by 2010 to "reduce" Japanese CO₂ emissions (MITI, 1998). Japan, as the first industrialised country in Asia, inevitably has a certain influence over the region's energy policy, with the expectation that its experience, no matter whether positive or negative, might be

replicated by its neighbouring countries. It is, therefore, important to assess Japan's future energy policy, to acquire a benchmark for the entire Asian region's policy orientation.

The topicality of the research lies in the fact that there are currently both external and internal shifting contexts. On the external side, the dangers associated with the nuclear option are increasingly recognised mainly in the West, and several countries are suspending their nuclear development. On the other hand, as briefly mentioned, the issue of global warming is currently attracting world-wide attention, and pollutants largely associated with the fossil fuel combustion are identified as the main contributor to the global climate change. Nuclear fuel is "theoretically" carbon-free energy source, and the nuclear industry, in particular, is keen to place the technology in the CO₂ abatement context.

Nevertheless, it is increasingly identified that the nuclear utilisation practically requires a considerable amount of supplementary power facilities, which are normally supplied by the existing energy fuels. In Japan, several hydropower sites are being developed purely to supplement nuclear power, which cannot adjust its output once in operation, no matter how much the demand level is.

The associated danger and inefficiencies as to nuclear development is now internationally recognised, to the extent that its deployment is not generally accepted as greenhouse gas mitigation option. Notably at the 5th conference of the parties (COP5) of the United Nations Framework Convention on Climate Change (UNFCCC) held in Bonn in 1999, the nuclear power option was ruled out by a majority of European Members and key developing countries².

On the internal side, the nuclear development is currently facing strong domestic opposition. Local resistances are fiercely intensified, involving the struggle between national and local interests, often virtually splitting small towns and villages in Japan. Lesbriel closely documents some of these local political

² Some scientists, including James Lovelock, who created the Gaia hypothesis of the Earth, made explicit that they support nuclear power as an action against the climate change (Lovelock, 2004). This research, though recognises the urgency attached to the climate change issues by those scientists, does not agree with their argument that the nuclear energy is “the safest of all energy sources” and carries only “the minute statistical risks of cancer”. The nature of the nuclear risks can be characterised with its broad and acute geographical and chronological effects: Once accident happens, radiation may damage a very wide area in one instant, and its effects will remain for generations. Its safety is questionable, as there are records of accidents in nuclear related facilities, if not big enough to be recognised internationally. The risks of accident will be even higher as the currently operating facilities become old. Also, we have to argue the credibility of the “statistics” to seriously look at the risks associated with it (For example, there are radiation exposures during the operation and checks, but it is not certain how much they are officially documented).

bargaining processes, though the observed local divisions are, fundamentally, the results of political and social inadequacies, rather than of the sophisticated negotiations as suggested. (Lesbriel, 1998).

The central government and the electricity companies are, for example, often criticised for the use of their financial strength to buy local favours. As will be discussed in Chapter 2, a large part of the energy budget has been liquidated during power plant siting negotiations. The funds distributed are normally allocated as agricultural and fishery, as well as residential, compensations. Once local residents receive the compensation, they are implicitly expected not to be against the power development, no matter what the new evidence is released to exhibit nuclear dangers. Local residents have to run a risk, if they wish to act against the original agreement. In the Maki nuclear development case, residents voted against a nuclear development project in a local referendum. As a consequence, an electricity company rejected them for the financial co-operation originally promised to an agricultural facility construction (Niigata Nippou-sha, 1997). They are also used to build public structures, such as local schools and agricultural facilities. However, experiences have demonstrated that the effects of the built facilities are often temporary, rather than long lasting. In fact, many local authorities are experiencing the immediate budget reductions after the promised

consolation runs out (Yamakawa, 1991).

Several local governments are beginning to demonstrate their veto on the allocated nuclear development, in many cases, after long local divisions. One of the examples is a prefectural governor's call for the cancellation of the Ashihama Nuclear power station application in 2000 (Nikkei, 2000a). It is widely believed that the Tohkaimura nuclear accidents, in September 1999, formed a strong basis for the public nuclear opposition (Nikkei, 2000b). The division between the government and the public perspectives has created a vacuum of policy and policy implementation, with little chance that Japan could meet the international GHG reduction obligation. With these backgrounds, the Roundtable for Nuclear Energy, an independent forum which has been established to foster a public debate on Japanese nuclear future, issued a statement to urge the use of scenarios to reduce Japanese nuclear dependency (Nuclear Policy Roundtable, 2000). The Roundtable sees the drastic reduction of nuclear dependency is, upon observation of the current situation, not practical. Nevertheless, it suggests the government should build scenarios to reduce the nuclear use to lower degree than the forecast level. The research accepts the significance of the recommendation in a sense that, though modest, it is the first official trial to demand the government to reconsider its strategy.

In order to review nuclear dependency, it is necessary to consider the whole energy supply and demand structures. Scenario analysis, as will be discussed later, is designed to help the reviewing process in the light of sustainability.

1.2 Strategic Energy Policy Assessment

On reconsidering the national energy strategy, there would be much to learn from the Strategic Environmental Assessment (SEA) argument. SEA initially emerged from the existing problems with environmental impact assessment (EIA) of individual development projects. Some insufficiencies have been experienced with project EIA for steering cumulative environmental impacts that may arise from an aggregate of several different projects (Glasson, 1999). In other words, SEA is responsible for providing frameworks for steering comprehensive environmental impacts, through the “strategic” levels of policy assessment.

As is going to be discussed later, there are currently few systems working in Japan to assess the effectiveness of its energy policy. Assessment of energy policy at the strategic level, therefore, seems to have a great implication for Japanese energy policy by providing a necessary evaluation mechanism for it. It is also expected

that, by incorporating a strategic level of assessment and public participation in its process, some advantages, such as the agreement between the government and the public, and optimised co-operation of the public may be achieved.

The overall aim of the research is to propose a framework for a national energy policy discussion. A strategic perspective is applied to the analysis, and the core research question is to see whether the strategic level of discussion between different parties could reduce the conflicts and divisions. To achieve this aim, a scenario exercise is employed to “visualise” the alternative options open to the country, so that the people who are currently not satisfied with the national energy policy could participate in the discussion.

Specific research questions include the following. What are the current energy supply and demand structures in Japan? How much energy does Japan really need? What kind of energy does Japan require? What would be the normative and desirable scenario for Japanese sustainable energy future? How can such a scenario be constructed and how can it be a validated vision by the public? What are the policy paths to the described future? If the wider actors involved in the scenario construction bringing them into a strategic decision, does it have any possibility of bringing social justice and operational efficiencies, for example by

reducing the local conflicts?

1.3 Japanese Hard Energy Path

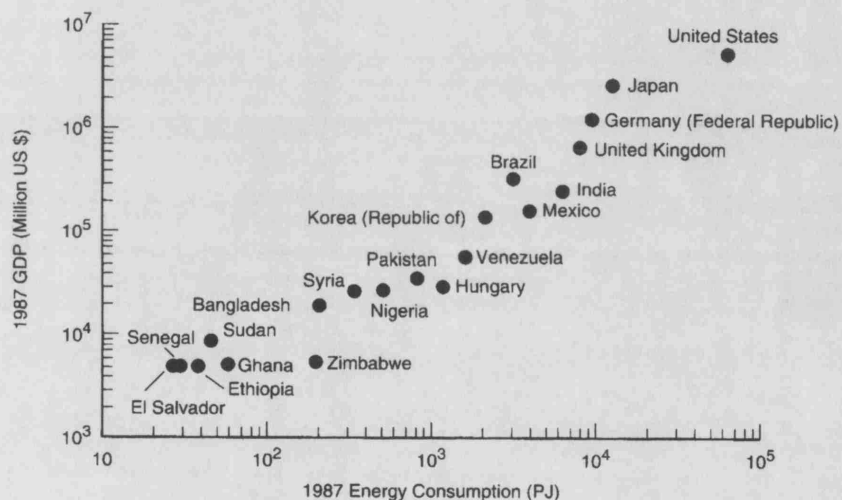
As discussed, Japan has been increasing its dependency on nuclear power, thus taking a “hard energy path”. This section introduces the current Japanese energy structures as a background to understanding the driving force for its policy.

1.3.1 Japanese Position as an Industrialised Country

Japan is in a controversial position when comparing its energy use with the other developed nations. It is certainly one of the most industrialised countries but has been industrialised much later in a historic sense, compared to its Western counterparts. Figure 1.1 shows the co-relation between energy consumption and GDP. From this figure we know that the level of energy requirement of Japan is similar to those in the Western industrialised countries. However, in terms of the structure of energy requirement, there is a gap between the western countries and Japan. For example, as is seen in Table 1.2, final consumption by industry in the US and UK is just above 25% of the total consumption of energy, whilst in Japan, it consists of above 40 %. In fact, as a structure of energy consumption, Japan

seems to show much greater similarity when it is compared with countries in economic transition, such as Korea. Table 1.2 shows the Japanese final energy consumption in different periods. When we compare the structure of Korea in 1995 and Japan in e.g. 1990, the figures appears to be comparable³.

Figure 1. 1: Commercial energy consumption against GDP for 20 countries



(Source: Edge and Tovey, 1995)

³ Kim and Shin (1986) pointed out the similarity between Japan and Korea's energy consumption structure.

Despite to the big difference in demand size, Japan's and Korea's general energy situations share many characteristics. ...In particular, an extensive conversion to coal and other energy sources in the industrial sector is essential to realise the policy objective, because the industrial sector accounts for 42% (Korea) and 53% (Japan) of total energy consumption (in 1985).

Table 1. 2: Total Final Consumption by sector percentage (1995)

	USA	UK	Germany	Japan	Korea	China
Industry	25.9%	27.3%	32.0%	42.7%	46.9%	66.2%
Transport ⁴	38.8%	30.8%	26.0%	25.1%	22.9%	8.8%
Domestic and others total	31.1%	35.3%	37.0%	28.8%	26.6%	22.4%
Agriculture	1.1%	0.8%	1.1%	3.2%	2.6%	4.1%
Public	17.7%	25.3%	25.5%	13.9%	20.2%	13.4%
Residential and others	12.3%	9.2%	10.4%	11.7%	3.8%	4.9%

(Source: World Resources Institute, 1998)

1.3.2 Scarce Indigenous Fossil Reserves, Oil Crisis and Energy Efficiency

Japan is regarded as a country with very scarce indigenous fossil fuel reserves, and it has been heavily reliant on imported energy sources, mainly oil from the Middle East. The oil imports from this area continued even after the oil crisis. The major oil companies shifted their policy to import non-Middle East oil to their home countries, but to continue exporting “vulnerable” Middle-East oil to Japan (Nihon Kagakusha Kaigi, 1980). The Japanese government created a mechanism to develop its own resources to import oil, by establishing a government funded company. The price of oil from this arrangement, however, is currently 1-2% more

⁴ It includes air and surface transports.

expensive than those of the major oil companies. Also, national policies between Japan and other countries, mainly the U.S., over oil development often involve political conflicts in the Middle East, which is beyond Japanese capability and interest (Hein, 1990). All of these elements lead to a perception among Japanese policy makers that oil market is under the strong control of the major oil companies. This perception, as well as the volatile political situation in the Middle East, formed the driving forces pushing Japan to move away from its dependency on imported oil.

As well as moving from high oil dependency, the Japanese government encouraged industries to take up energy efficiency and pollution control measures after the oil crisis. There was a fear that Japan might be “losing its battle” again, before becoming a recognised industrial country, because of possible lack of oil. Adoption of energy efficiency measures was, then, accepted by industries as crucial for the country’s survival.

It is not a coincident that energy efficiency caught the wider public acceptance during 1970s-80s when various pollution incidents, in which heavy oil dependency played its part, triggered social outrages⁵. There was a general

⁵ For example, Yokkaichi Asthma incidents has been often quoted for explaining the how a local

consensus that the associated social costs from the pollution incidents outweighed economic benefit arising from avoidance of pollution control. This led to an acceptance by the Japanese industries as to the tightening of national/local pollution legislation, as well as the investment plans which involves significant amount of money (Kuroki, 1996).

Unlike the common perception, therefore, energy efficiency is not purely a product of a strategy to promote national export strength by improving technological excellence. It was also out of contrition over the national oil dependence and the associated pollution incidents. The degree of seriousness as to energy efficiency and pollution abatement among Japanese during this period has been represented by various indicators, one of which is the energy intensity for OECD countries, showing the increased Japanese energy efficiency per GNP (Table 1.3). Also, pollution abatement investment amounted to more than 17% of

atmospheric legislation effectively reduced the sulphur dioxide levels in the area. The significance of the incident is, however, rather in the fact that this former military base was converted into a major industrial production area, partly under the US policy on Japanese economic revival, burning the imported oil without sufficient pollution control measures. As a result of this, there were a growing number of asthma sufferers, and Yokkaichi local authority introduced a covenant on pollution control which was agreed with the local industries. The covenant later became a model for other local authorities to have the similar approach, especially when the national environmental standards are thought to be not sufficient.

total annual capital expenditure at a time in Japan (Figure 1.2). As a result of this, nearly 100% of the fossil fuel powered power stations in Japan have been equipped with flue gas desulphurisation. The cost for pollution abatement technologies was so high that some domestic industries suffered a devastating impact.

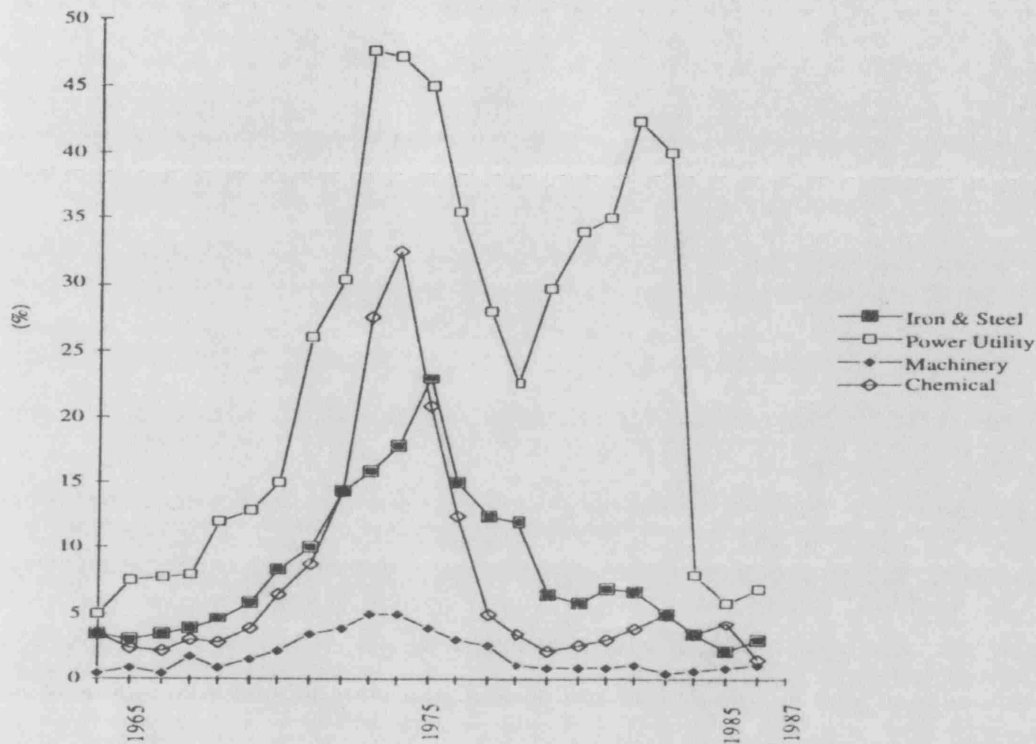
After the oil crisis, oil stockpiling became one of the important strategies for energy security. Japan keeps a high volume of oil stockpiling under the 1975 Japan National Oil Corporation Law. The private sector reached 90 days stockpiling in 1981, but their obligation was reduced to 70 days in 1988, which has been maintained since 1993. In March 2000, the government reserve was 47.5 million kl, while the private reserve was 42.2 million kl., total 160 days stocks were reached.

Table 1. 3: Energy Intensity⁶ for OECD Countries

Country (World Region)	1973	1979	1988	1990	average annual growth rate (%) 1973–1990
North America					
Canada	.55	.52	.41	.3	–1.9
United States	.44	.40	.31	.30	–2.3
Pacific					
Australia	.35	.35	.31	.31	–0.7
Japan	.29	.24	.18	.18	–2.8
New Zealand	.35	.35	.41	.42	1.1
Europe					
Austria	.35	.33	.29	.28	–1.4
Belgium	.58	.51	.39	.37	–2.6
Denmark	.36	.33	.23	.22	–2.9
Finland	.50	.44	.36	.36	–1.8
France	.35	.31	.25	.24	–2.3
Germany	.39	.36	.30	.27	–2.0
Greece	.38	.38	.40	.42	0.6
Iceland	.48	.35	.31	.34	–2.0
Ireland	.45	.43	.35	.34	–1.7
Italy	.33	.29	.24	.24	–1.9
Luxembourg	1.43	1.18	.77	.79	–3.4
Netherlands	.49	.47	.39	.36	–1.8
Norway	.39	.36	.30	.29	–1.8
Portugal	.39	.43	.49	.49	1.4
Spain	.31	.3	.30	.29	–0.3
Sweden	.44	.41	.31	.29	–2.4
Switzerland	.21	.21	.19	.19	–0.6
Turkey	.66	.62	.60	.58	–0.7
United Kingdom	.39	.36	.29	.28	–2.1
OECD Total	.40	.37	.29	.28	–2.2

⁶ Energy consumption per real GDP (tones of oil equivalent per thousand US\$ at 1985 market prices) from IEA data. The graph taken from McRae (1994).

Figure 1. 2: Ratio of pollution prevention investment to total investment



(Source: Kuroki, 1996)

Although the energy efficiency measures were initially a reactive (rather than an active), response to higher fuel prices, the competitiveness gained through the energy efficiency has been increasingly important for Japan to maintain its economic activity. In the meantime, as a result of lower oil price since the late 1980s, as well as other factors such as the growing demand for higher living standards, Japanese energy efficiency has somehow dwindled. There are also international factors contributing to the stagnation over energy efficiency, such as

pressure from the US for Japan to reduce "non-tariff trade barriers". As will be mentioned in Chapter 2, the commodity tax, which charged a higher rate for large-sized cars, was abolished in 1989, resulting in Japanese consumers being encouraged to purchase cars which consume more energy.

1.3.3 Emergence of Nuclear Option

On the other hand, in order to diversify energy sources, the Japanese government started to look at nuclear option in the 1970s. The atoms-for-peace movement in the US was substantiated, and it created an atmosphere in Japan that this relatively new form of energy represented a major opportunity to shift away from oil dependency.

The Japanese government started to invest heavily in nuclear related researches especially on light water reactors (LWR). It was later perceived that uranium required by LWR operation was scarce and its degree of availability was thought to hamper the wider use of domestic LWR. The government and general electric utilities, which are private companies but hold regional monopolies, started to explore the possibility of fast breeder reactor (FBR) application and of the associated fuel recycling practices.

Currently, the safety problems and other related disadvantages of the combination of LWR/FBR are well recognised in the most of Western countries. Also, plutonium created through LWR/FBR operation is posing a significant threat to Japan itself in terms of waste management, as well as creating an unnecessary suspicion for Japanese military ambition, though the post-W.W.II Japan recognises little benefit to have nuclear defence power under the current international regime.

Despite the disadvantages of nuclear reliance, the Japanese government remains interested in the nuclear option. The nuclear option is reserved as a means to satisfy its energy demand and to “not to place the country in the hands of potentially volatile energy exporters” (Edge, 1999). The financial involvement, also, is recognised as one of the biggest elements which hinder Japan to switch to any alternative option.

“Japan has been reluctant to follow this route because of its near total dependence on imported fuels. Even if energy security were not an issue, Japan’s considerable investment in nuclear power argues against a sudden change in its

long range plans to rely on nuclear power for a significant fraction of its electrical power needs. (Lidsky, 1998)”

As a result, the Japanese nuclear dependency has reached to the extent which the country itself is nearly “painted into a nuclear corner”, where changing direction is highly difficult. Getting out of “the corner” is seen to require considerable “imagination and leadership in energy matters” (Edge, 1999).

1.3.4 Secrecy over Nuclear Safety

It is not only in Japan where secrecy over nuclear safety raised public concern. Secrecy among responsible administrations for the US nuclear programmes fuelled public suspicions among the American people (Camilleri, 1984). History clearly repeats in Japan, where the answerable organisations are criticised for concealing critical information from the public for a sequence of nuclear accidents, which are shown on the Table 1.4.

Table 1. 4: Major nuclear accidents and scandals in Japan (since 1990)

Date	Plant	Description
February 1991	Mihama No.2	PWR water pipe damage
December 1993	Tokai Reprocessing Plant	Radioactive leak
December 1995	FBR (Monju)	Sodium leakage
March 1997	Tokai Reprocessing plant	Fire accident
April 1997	Fugen	Tritium leakage
September 1999	JCO Reprocessing plant	Nuclear leakage
August 2002	Tokyo Electric Company	Falsification scandal on inspection data

Despite these allegations, technical safety over nuclear development has been emphasised by both the national government agencies and power industries. The most common attitude of the government and industry is to limit the scope where the modern technical safety measurement could apply, and to dismiss unexpected miscalculations often as “mere exceptional operational failures”, as on the Japan Conversion (JCO) accidents (Amagasa and Nishio, 2000). There are, however, crucial facts that operational failures are not uncommon to this industry anywhere. The recent data fabrication scandal of the British Nuclear Fuel Laboratories (BNFL) revealed that low work ethics could prevail (Independent, 1999).

1.3.5 Energy Forecast

The situation in Japan has been exasperated by the tendency that the public are only given a single prepared energy orientation, with no alternative choice. Under the current policy formation system, the national energy demand-supply forecast has been playing the significant role in deciding the Japan's energy structure. "The Long-Term Energy Forecast", a projection prepared by the government department (METI), has been criticised as it gave distorted priority over economic growth, rather than reasonable policy intervention on energy demand management (Kihara, 1990, Karasawa, 1990, Nishikawa, 1997, Oshima and Uezono, 1999). The forecast energy demand increase and the concerns over the global warming through fossil fuel combustion are then placed as rationale for the nuclear deployment.

In addition, there is a concern that the current Japanese energy policy situation exhibits democratic failure⁷. The government forecast is not assessed by the Parliament: it is prepared by METI and its committee, and then endorsed only by

⁷ This concern formed a basis for the creation of a study group for alternative energy, consisted with Japanese Members of Parliament, called Green Energy Law Network. Their activities are introduced at <http://www.jca.apc.org/~gen/index.html>.

the Cabinet. In this circumstance, there is little room for public scrutiny.

1.3.6 Japanese Soft Energy Path

As has been reviewed, the government's priority has been given to the exploration of various nuclear technologies, with a vast amount of financial investment. On the other hand, the choices other than the nuclear option have met significantly less financial support from the government. For example, renewable energy R&D shares only about 3% of total energy R&D expenditure, while the majority of the budget goes to nuclear research (IEA, 1999)⁸. It is suggested that this financial structure is largely unchanged since it was criticised by Lovins in 1975.

"To illustrate the danger of not realising how wide our range of choices really is, consider Japan, widely regarded as the industrial country most desperately short of energy and land. A line of technically sound reasoning suggests that Japan can attain an economy of energy income (as opposed to energy capital, or fuels) directly – without an intervening stage of reliance on nuclear fission – merely by devoting her resources to the former rather than the latter." (Lovins, 1975)

⁸ The Section II of the thesis will discuss the Japanese energy R&D budget.

Recently, several energy studies presented energy futures (IEE, 1999), (Kaya, 2000). The limitation of these studies, however, is that they are based on the current trend, and they are less powerful where the current trend is weak in achieving sustainability. In that sense, they have little merit in providing us the alternative vision where stronger future actions are required.

It is often the case that the images of alternatives are difficult to perceive, and people are not able to choose options which they can not imagine (Lovins, 1975).

In order to support the public to conceive the images of alternative choices, there is a need to clearly demonstrate them. Thus, the primary responsibility of the energy strategist has emerged as:

The energy strategist must not only develop tools to help the political process to explore such choices; he must also encourage a fundamental re-examination of the social role of energy, of the difference between demand and need, and of the possibility of achieving liberal social goals without rapid, or even any, growth in the rate of consumption of primary energy stocks. (ibid.).

With this role in mind, the research adopts a method to demonstrate scenarios for a normative and desirable future, which is called backcasting analysis. Prior to

exploring the potential of backcasting, the next section examines the context and origin of the methodology, in contrast to some other approaches to future studies, especially the forecasting methodology.

1.4 Methodological Framework and Research Objective

1.4.1 Forecasting and Backcasting

During the post W.W.II. period, the industrialised nations saw the significant increase of material and energy consumption, and waste discharges associated with such process. It was in the late 1960s that a fundamental question was raised on the long-term prospects of the highly industrialised societies. As a response to the question, a number of studies to forecast the future state of the human industrialisation were commissioned (Miles, 1979). Those forecasts emerged as a prediction of the outcome of the pursuit of resource consumption and waste discharges.

The most quoted example of the studies was conducted by Meadows and his colleagues (Meadows, et. al., 1972). Using numerical inputs, it predicted an exponential growth of human population and the catastrophic future for industrial

development. The novelty of Meadow's forecast is to bring the ecological capacity idea to the growth of the human race, and it challenged the forecast studies which normally assume linear growth of the economy. There is no doubt that the new type of forecasts has played a significant role in warning about the "unsustainability" of unconstrained industrial growth.

Forecasting, however, has been prone to criticisms in several points. For example, forecasting, defined as "a process which has as its objective the prediction of the future events or conditions" (Levenbach, 1981), holds an insufficiency that it can not be perfectly precise to take account of the uncertainty surrounding the future. (For example, the studies of Meadows have been criticised in a sense that the predicted catastrophe has not yet come.)

Forecasts are faced with another crucial limitation in the situation where the predicted future is undesirable, and what is needed is a system to break the trend, rather than continue it. Alternative future visions, as well as actions to change the course, are required, if it is to avoid the unsustainable future which the forecast studies predict.

Also, forecasting is often noted, especially in the context of transport planning, as

being a mechanism to justify the "predict and provide" approach (Owens, 1995). For example, based on the before-and-after studies, Skarmis and Flyvbjerg pointed out that traffic demand forecast has tendency to be systematically overestimated, while cost calculation to provide infrastructure underestimated (Skarmis and Flyvbjerg, 1997). The essence of the criticism is that forecasting has been too often used by the decision makers to provide a single choice, then to proceed to the infrastructure construction, which usually involves political negotiation.

The conflicting energy forecasts both at the national and global levels are - besides their scientific content - also expressions of a political negotiation process: a process that has been transferred to a meta-level, where political, administrative, and industrial interests compete for cognitive and methodological hegemony over the definition of the energy future through modelling (Baumgartner, 1987).

In the energy context, the rethinking over exponential forecasting, as well as the western economies' stagnation made the predicted energy demand revised downwards during 1970s and 1980s. There was also the growing recognition that the exponential forecasting was instrumental to the justification over the set of

existing assumptions and policies (Robinson and Hooker, 1987). As a result, for example, in West Germany, the exponential forecasting was gradually replaced by new analytical methods involving the scenario analysis "which make political decisions with respect to energy supply the normative basis of analysis" (Diefenbacher and Johnson, 1987). The German case may be seen as an example of prototype application of the "Backcasting" methodology, which will now be explained.

Backcasting methodology, first articulated by Robinson, is a way to assess the energy and sustainability problems in a systematic schema. Its main purpose is to identify policies and actions required to achieve a certain desirable future, rather than to predict of most likely future based on current observations.

Backcasting involves working from a normative future, to identify how the future could be achieved, through a range of policy measures. The major difference between the forecasting and backcasting methods is that the latter concerns the "implications of different policy goals", while the former indicates "what the future will likely be" (Robinson, 1982). The fundamental philosophy behind the backcasting is a will for a discovery and understanding, rather than causality over the things that happen (Dreborg, 1996).

While the emphasis in forecasts is on investigating the underlying structural features of the world that would cause the future to come about, the emphasis in backcasts is on determining the freedom of action, in a policy sense, with respect to possible futures (Robinson, 1982).

For the backcasting exercise, scenarios are normally developed to visualise the path leading to the desired future. A scenario is often classified as one of the forecasting techniques, as it is able to present wider range of different options as a package, which constitutes a distinctive advantage over the other forecasting techniques. Also, other forecasting techniques, such as brainstorming⁹ and Delphi¹⁰, are primarily concerned with producing estimates of the probability of a future event, and for these techniques, most of the assumptions are accepted as given. On the other hand, in a scenario exercise, "unlike other forecasting techniques, several alternatives are developed in their own right, rather than with a probability distribution" (Jones, 1978). In other words, a greater value is attached

⁹ Brainstorming is a technique "conducted by a group of people who attempt to solve a specific problem by collecting all the ideas spontaneously contributed" (Jones, 1978).

¹⁰ Delphi method is "based on a structured process for collecting and distilling knowledge from a group of experts by means of a series of questionnaires interspersed with controlled opinion feedback" (Ziglio, 1988).

to development of alternative futures in scenario construction, and this enables scenario to be an essential technique for backcasting which requires the freedom of choices, away from a "given" future vision.

Special care is needed for the use of the term “scenario”, as it should specifically reflect its literary origin. It is referred by Lovins as “a description of how future events unfold, described chronologically and at least qualitatively in sufficiently vivid detail that readers can readily imagine themselves participating in the events it describes” (Lovins, 1977). Thus, a scenario must be not confused with other similar but different types of exercise, such as a forecast or a projection.

Energy backcasting has been carried out in several countries, mainly in Sweden and Canada. In Sweden, the two polarised futures were developed prior to the national nuclear referendum, and they had a significant impact for the country’s energy strategy (Lonnroth, et. al., 1980). In Canada, Robinson has carried out a number of relevant researches. One of his studies proposed a sustainable future in 2030. (Robinson, 1996a).

This method, however, is largely unknown by Japanese energy policy makers: There is no case that this method has given a serious consideration as a tool for

exhibiting the country's sustainable future. The application of this approach would seem to offer a great potential in demonstrating the challenges that Japan currently faces. Therefore, this research will take the following four steps to apply the backcasting methodology to the Japanese energy context: 1) scoping: choice of criteria and targets, 2) creating Images of the Future, 3) creating paths to the Images, and 4) identifying robust and adaptive policy packages. The details of the methodology will be elaborated in Chapter 4.

1.4.2 Scenario and Other Approaches

Japan has accepted a COP3 obligation to reduce its annual greenhouse emissions to 6% below the 1990 level between 2008 to 2012 period. There are currently some scenario studies carried out to see if Japan could meet this obligation. The scope of these scenarios are inevitably limited to the period up to 2010 (CASA 1997, WWF Japan 1997).

The longer time scale, however, is required for soft energy path analysis, if the issues such as turnover of capital stock are taken into account (Robinson, 1982). On the other hand, the application of scenario study to very long-term time scale holds rather less significance. For example, scientists believe that the world, hence

Japan also, will have to face an enormous CO₂ reduction target up to the year 2100 to 2300, in order to stabilise the atmospheric CO₂ concentration. There is a clear need for a short, medium and long term policies and strategies to meet such very long-term reductions. However, the external and internal contexts associated with the situation will be largely unpredictable. Therefore, it would be much more practical and meaningful to focus on the medium-term time scale to construct a scenario. For this reason, the research adopted 2030 as the provisional end-points time set for the analytical purpose¹¹. It recognises, however, that the value of scenarios that cover much longer period, such as 2050 or 2100.

In the existing scenarios, CO₂ is given a priority for reduction. There is accumulation of evidence that CO₂ has potential to cause global warming, and its tighter control is urgently required. However, to emphasise the danger of CO₂ without reference to the danger of other substances, is not justifiable. Pro-nuclear advocates are keen to place nuclear development in the context of CO₂ and other GHGs reduction. The dangers associated with nuclear to human and other living organisms are profoundly acute and persistent. It is, therefore, important to pay attention not only to CO₂ and other GHGs, but also to the pollutants such as

¹¹ The main purpose of this research is to “break the trend”, and it sees the time scale identified here is suitable to allow creative thinking required for that purpose.

sulphur dioxide, nitrogen oxides, radioactive materials and others. The Chapter 4 will discuss how those pollutants can be treated in the consideration on scenario target.

1.4.3 Selected Strategy

For the creation of scenarios, it is necessary to identify several possible strategic choices. Strategic choices can be formed with the following parameters:

- 1) whether energy policy should be supply-led or demand-led; or
- 2) whether emphasis should be more renewable-energy-led or non-renewable energy-led (fossil basis and nuclear basis).

Here, there is a need to define different energy types with great care. For example, nuclear fuel is, *inter alia*, a controversial energy source, and is often confused as a renewable energy source. It is, therefore, important to distinguish different energy types. Renewable energy sources are defined as “those that are replenished by natural processes at rates exceeding their rates of use for human purposes” (Eblen and Eblen, 1994). To elaborate, renewable energy sources can be referred to as “flow-limited”, as the rate at which they can be sustainably acquired is limited by

the size of the natural replenishment flow. On the other hand, “stock-limited” energy sources, like the fossil fuels, natural replenishment is very slow in comparison with use rates (*Ibid.*). For the nuclear fuels, there is no natural replenishment. In this research, therefore, the nuclear fuel is not categorised as a renewable energy source.

Another consideration is required as to whether we should separately discuss fossil fuel (whose natural replenishment is very slow) and nuclear energy (whose natural replenishment is non-existence). The fossil fuels are widely used, and its by-products upon their combustion, especially CO₂, are recognised as the main cause of the global climate change. Nuclear energy, though it requires a considerable amount of supplemental energies, is theoretically carbon-free, and it should be treated as differently from the fossil fuels. The research, therefore, divide non-renewable energies into fossil and nuclear fuel basis.

For supply-led approach, the main emphasis is on meeting the current energy demand, by maintaining or increasing supply capacity. For demand-led approach, consideration will be given to the reduction of energy demand level. This would ease the need to maintain or increase supply capacity. Renewable-led approach requires their increased proportion in the energy supply structure.

Non-renewable-led (fossil fuel basis and nuclear fuel basis) approach signifies the use of fossil and nuclear energies. These approaches can be combined to form different scenarios, as are conceptualised in the following diagram.

Figure 1. 3: The different strategic options

	Non-renewable-led (fossil)	Non-renewable-led (nuclear)	Renewable-led
Supply-led	Ia BAU ¹² (Reference scenario)	Ib Increased rate of nuclear associated problems, such as waste	III Financially stretching
Demand-led	IIa Extensive DSM ¹³	IIb Continuation of nuclear associated problems	IV Environmentally desirable

These strategic options are, in reality, not mutually exclusive, but these are here to demonstrate a simplified view as to the variety of available choices and their problem and desirability.

These strategic options will be further elaborated in the Chapter 4, therefore, only the sketch of these options is provided here. The combination of supply-led and

¹² BAU stands for Business As Usual.

¹³ DSM stands for Demand Side Management.

non-renewable-led approaches does not call for any significant change from the current Japanese energy situation, implying that the business-as-usual continues. If nuclear supply increases, without the reference to the demand control, nuclear associated problems, such as the waste generation, will increase. However, even if there is something done about energy demand, as long as the nuclear-led strategy is in place, the problem continues. Renewable-led approaches, without reducing the demand level, could require considerable financial and other resources to drastically increase the renewable capacity to meet energy demand. If demand-led approach is taken, but the use of non-renewable energy sources continues, any significant reduction of pollutants could not be achievable. The combination of renewable-led and demand-led approaches could represent a win-win situation, with environmentally and financially reasonable outcomes, and the research will be primarily concerned with how to make the transition from the scenario I (BAU) to the scenario IV.

Consideration must also be made on whether it is environmentally desirable to move from the scenario Ia to IV through a strong concentration on the fuel switching, then gradually phasing the demand management into the context, or first introducing demand management before bringing fuel switching into the scene. There are, however, also many possible combinations of these strategic

options. The research attempts to examine those possibilities and it is one of its tasks to integrate them in the scenario analysis.

There are a growing number of discussions on how to take physical and ecological values into consideration of the degree and kinds of policy formulation.

The "weak versus strong" sustainability debate is, *inter alia*, to provide the basis for such discussions. For example, very weak sustainability requires only "that the stock of capital assets should remain constant over time", whereas very strong sustainability "call for a steady-state economic system based on thermodynamic limits and the constraints they impose on the overall scale of the macroeconomy" (Turner, 1993). The weak and strong sustainability relates to fundamental variance in terms of necessary political, economic and social contexts.

The question is how weak, as well as strong, sustainability relates to the Japanese energy scene, and how different options could be connected with the different degree of sustainability strength. If we consider sustainability as a paradigm which only imposes maintenance of the constant capital assets (as the very weak sustainability requires), energy consumption and economic expansion through the energy consumption will be justified as long as man made capital is made through them.

On the other hand, if the world thermodynamics, which often reveals the fact that the current global energy equilibrium is unbalanced, is taken into account, a strong sustainability approach will be justified, and this means some strong limitations on energy inputs to a society, and this probably requires strong restrictions on energy demand. The research, thus, takes the position to justify the option IV in the context of strong sustainability argument. (This issue will be further discussed in the Chapter 4.)

1.4.4 Path to the Normative Scenario and Scenario Validity

For scenario analysis, it is not sufficient to present the normative and desirable future: Significance lies in the paths to the future and the choices available to get to that position. Also, policies, which shape the choices, must be shown, so that the orientation of choices will be made through policy debate. The target of the research is, therefore, by taking this challenge, to demonstrate required policies and choices leading to the selected individual scenarios.

One of the critical vulnerabilities of the backcasting analysis is related to its validity and feasibility. A normative scenario can be created that is too idealistic to

achieve, or, even when the scenario is not “too idealistic”, there is simply no translation mechanism for putting the scenario into practical application.

The research tries to overcome those situations through optimising interaction with key actors, with taking their inputs to the scenario formation process to enhance both validity and feasibility of the normative scenario. This will be done through the following procedure.

1. Building of provisional scenario
2. Selection of key actors
3. Collecting opinions of the key actors on the provisional scenario, through a set of questionnaires
4. Modifying the provisional scenario to reflect the opinions

As will be further discussed in the later chapters (i.e. Chapter 5 and 7), great care is necessary to take the balanced views from the key actors. The research takes the view that inclusion of the people from the different backgrounds, such as the government, industry, academics and environmental groups, will keep such a balance.

1.5 Contribution and Limitations of the Research

1.5.1 Contribution of the Research

Energy policy studies are still in their infancy in Japan. The research tradition is relatively weak in contributing to the public understanding on national energy policy, thus leading to a situation where the government-formulated forecast is accepted without sufficient discussion. Although there are some notable exceptions which attempted to exhibit strategic energy choices (CASA, 1997), some of the works tend to reflect the introduction of the Western information without a rigorous methodological structure. Japanese academia in general has a tradition to value the Western information ever since the Meiji Reformation in the 19th century, and it is certainly true that the scholarly efforts have helped to stimulate the country to carry out its political, social and mental modernisation¹⁴. For example, in the environmental sphere, the European Union (EU) practices are

¹⁴ Some argue that one of the distinct differences between Japan and the rest of the Asian countries originated from the history that Japan has not been colonised because of its geographical and other reasons, hence has been able to keep its relative autonomy. With its fortunate background, Japan has been willing to introduce the Western modernism rather voluntarily (Kato, 1980). This forms contrasts with some other Asian nations which were forced to adapt to the foreign systems, such as the Western and Imperial Japanese.

frequently quoted as pro-environment examples, with some exaggerations from good intention. However, what is currently needed is not just the Western information, but an attempt to establish the social system to create policies which fit to the Japanese domestic and external requirements.

This research intends to provide a basis for the national discussion, by presenting a normative scenario, with required policy measures for achieving it. In terms of detailed policy implications, the research offers four main contributions. First, it provides an example of how a normative future can be constructed as a scenario. Second, it demonstrates and analyses the potential policy and policy intervention impacts. Third, it highlights the value of the public debate at a strategic level, both in terms of social justice and operational efficiencies. Fourth, the research intends to maximise the interaction with the relevant actors with a various backgrounds, and this methodology is to contribute to enhance both validity and feasibility of the normative scenario.

1.5.2 Limitations of the Research

The research locus is Japan as a country, and this poses external and internal limitations. It is believed that the proposed methodology could have significant

implications for any other political or social entities, such as East-Asian countries, which are currently demonstrating certain policy similarities with Japan¹⁵. The research findings on specific policy analysis are, quite naturally, inherently specific to Japan, and its direct external application may be difficult. Internal limitations originate from the fact that the research focuses on the policy changes primarily at the national level. Although the research will illustrate required local policy changes, any fluctuation at a much more local scale may not be given a full detailed account.

1.6 Thesis Organisation

The aim of the first chapter has been to introduce the topic of soft energy path in Japan, to present the aims and analytical framework of the research and to provide a background to issues of energy development. The chapter has outlined the rationale, objectives and methodology of the research.

Chapter 2 places the study within a wider context of energy discussion and approaches in Japan. The literature on energy development in Japan is then reviewed, identifying key issues and approaches, and providing a brief

¹⁵ Chen Li-Chun pointed out similarities between Japan and Taiwan, in terms of energy supply-demand structure and industrialisation process (Chen, 1999).

introduction to the social, economic and institutional contexts related to the Japanese energy policy.

Chapter 3 reviews the currently proposed scenarios. Information from the government and quasi government sources, as well as NGOs and private research institutes is presented and analysed, paying particular attention to the methodological aspect.

In Chapter 4, 5 and 6, normative future scenarios will be presented. The role of each of the “actors” will be identified to achieve the scenarios. Also, the ideal schedule of the policy introduction and their impacts will be assessed.

Chapter 7 verifies feasibility of the normative scenarios by inviting the comments of key “actors”. Their inputs will be added to each scenario to revise its suitability to the Japanese context, while care will be taken to maintain the imaginative character of the normative scenarios. It also discusses whether the alternative scenarios have helped the national strategic argument.

The final chapter sums up the principal conclusions of the study and examines their implications for the relevant analytical and operational debates. It also makes some recommendations for policy processes and identifies questions for future study.

Chapter 2: JAPANESE ENERGY OVERVIEW

2.1 Backgrounds for Current Japanese Energy Issues

In this chapter, the main profiles of Japan are provided. In the West, there has been a split perception as to Japanese environmental attitudes in general. Some emphasise its anti-conservationist position by quoting, for example, whaling and exploitation of tropical rain forests. In the context of climate change discussion, Japan is largely in line with the US and its umbrella countries, which support their domestic industry's interests over the wider environmental concerns.

In fact, Japan is far from active in promoting the ratification of the Kyoto Protocol. Japan, as an umbrella country of the US, does not accept the concrete ceiling argument, mainly advocated by the EU countries, that a certain percentage of domestic action should be required for GHGs reduction (ENDS Daily, 2000). Japanese industry is also known to push nuclear energy to be included in Clean Development Mechanism credit. On the other hand, some others praise Japan as one of the most energy efficient countries in the world (though this type of admiration is often made to support the West's self-criticisms).

So, what is the real picture? Is it true that Japan is technologically far advanced and is it exploiting its advantage to further the world market penetration of its energy efficient products? Or, is it so lagging behind the Western counterparts as a result of lack of actions by the government, industry and consumers?

Although providing the answer to these question is not in the scope of this research, it is observed that the nature of the environmental problems and the environmental policies are fairly consistent among the "developed countries", and only the extent to which the environmental policies and implementations taken place is (often slightly) different.

For example, Norton reviewed the renewable energy contribution in Japan and the UK (Norton, 2000). In 1998, the UK renewable share was 2.6% of electricity generated, which equals to 0.9% of the total supply of energy. The figure, however, includes hydropower. The Japanese renewable share was 1.1% of the total energy, but the figure includes paper mill wastes and excludes hydro and geothermal power (Table 2.1).

Table 2. 1: UK and Japan renewable shares

UK	Japan
1998 -2.6% of electricity generated: equals 0.9% of total energy But includes hydropower	1998 -1.1% of total energy But includes paper mill wastes and exclude hydro and geothermal power
Thus on common basis: Including hydro etc: 0.9% Excluding hydro 0.35%	4.0% 0.34%
2010 -10% of electricity generated equals 3.5% total energy But - on common basis: Including hydro/geothermal: 3.5% Excluding hydro/geothermal: 2.0%	3.1% of total energy 7.1% 2.15%

(Source: Norton, 2000)

The review also compares renewable introduction targets up to the year 2010, and pointed out that, although the UK's 10% renewable target is considered to be ambitious, this percentage is against total electricity production. The Japanese target of introducing 3.1% looks modest, but is against total energy production. The "like and like" comparison, therefore, demonstrates that both countries renewable targets by 2010 are along the similar line: 3.1% and 3.5% of total energy respectively for Japan and the UK.

This chapter thus began with providing a snapshot of the Japanese energy performance, using its renewable energy target, in a comparison with the UK

context. In the following sections, it continues to provide the current energy profile, together with organisation and financial structures relevant to the energy issues, and the historical contexts behind Japanese energy policies. These are here to create an understanding as to the options available to Japanese future energy policy.

2.1.1 Geographical Profile

Japan consists of main 4 islands and smaller islands, with the total size of 362,133 sq. km (MCA, 2000), which are spread in the Northern Hemisphere. The north part is the sub-arctic, while the south is subtropical. Summer months are June to August, whereas winter months are December to February. The average temperature in Tokyo is about 25C° in August and about 5C° in January. The temperature difference between the Pacific Ocean and the Eurasia Continent brings humid air in summer, while in winter, it brings snow deposit on the North East region and dry air to the South West. The late summer sees typhoons which bring torrential rains and wind which often have destructive powers. The combination of temperature and humidity often create uncomfortable climate, especially during summer season, which explains recent growing demand for air conditioning.

67% of Japanese land is covered by forest, and 13% by the agriculture. The areas for these two are decreasing from 1965 when the figures were 74.2% and 19% respectively (Table 2.2). On the contrary, urban (5%) and transport (3%) use is gradually increasing (NLA, 1999).

Table 2. 2: Land Use Change in Japan

(Unit: 1000 ha)

	1985		1996		1997	
Agriculture	5,480	14.5%	5,080	13.4%	5,040	13.3%
Forest	25,300	70.0%	25,130	66.5%	25,120	66.5%
Mooreland	310	0.08%	260	0.07%	260	0.06%
Water courses	1,300	3.4%	1,330	3.5%	1,330	3.5%
Road	1,070	2.8%	1,220	3.2%	1,230	3.3%
Urban	1,500	4.0%	1,720	4.6%	1,740	4.6%
Others	2,820	7.5%	3,040	8.0%	3,060	8.1%

(Source: National Land Agency, 1999)

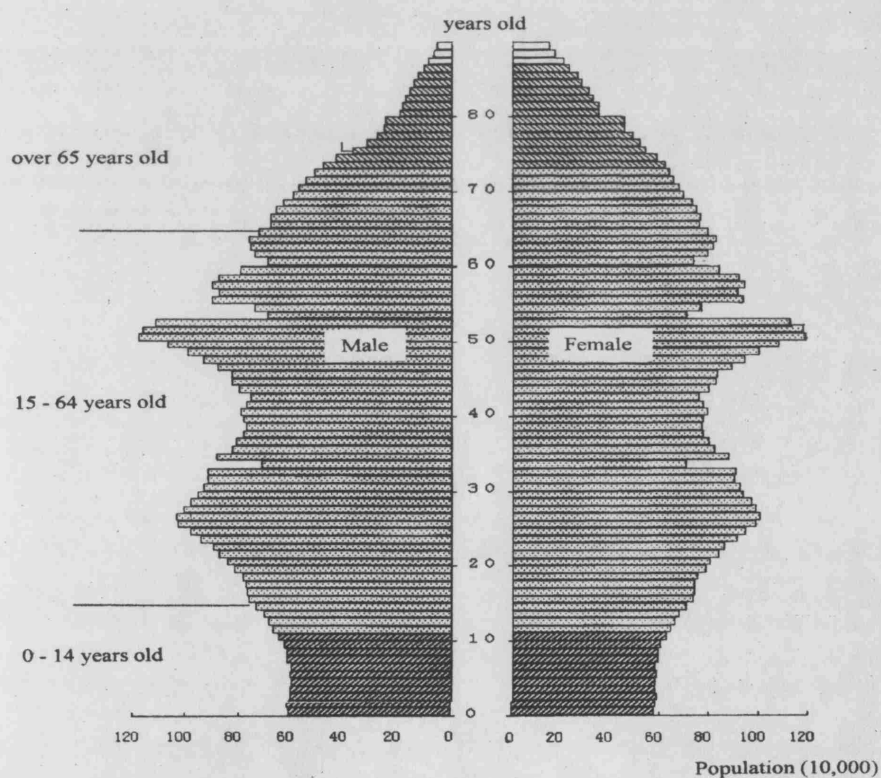
2.1.2 Demographic Profile

The population of Japan is 126.7 million in 1999, making it the 8th most populous country in the world (MCA, 1999a). Population density is 338 per sq. km, the 4th highest density among the countries with over 10 million populations in the world (MCA, 1996).

The Japanese population is expected to reach its peak in 2004, with 127 million, and then will gradually decrease. With less than 0.2% population growth in 1999,

ageing is creating a great concern in Japan. The population over 65 years old accounts for 16.7% of the total in 1997, and its share is to increase up to about 30.0% in 2030. This suggests the dependency ratio will increase, while the workforce population will decrease. These could lead to the scaling down of the whole economy size (Figure 2.1).

Figure 2. 1: Population structure in Japan



(MCA, 1999a)

Household numbers are increasing, from 41.8 million in 1990 to 43.9 million in

1995. Of the total household, "nuclear family" shares 58.7%, and single person household shares 25.6%. Overall, the average household size is getting smaller, with 2.82 persons in 1995. (MCA, 1996). Energy consumption associated with smaller number of population could be offset by the increase in numbers of households. Also, as will be discussed later, energy consumption of the residential/commercial sectors is on the increase, as a result of greater use of electrical equipment, such as air conditioning and other consumer goods.

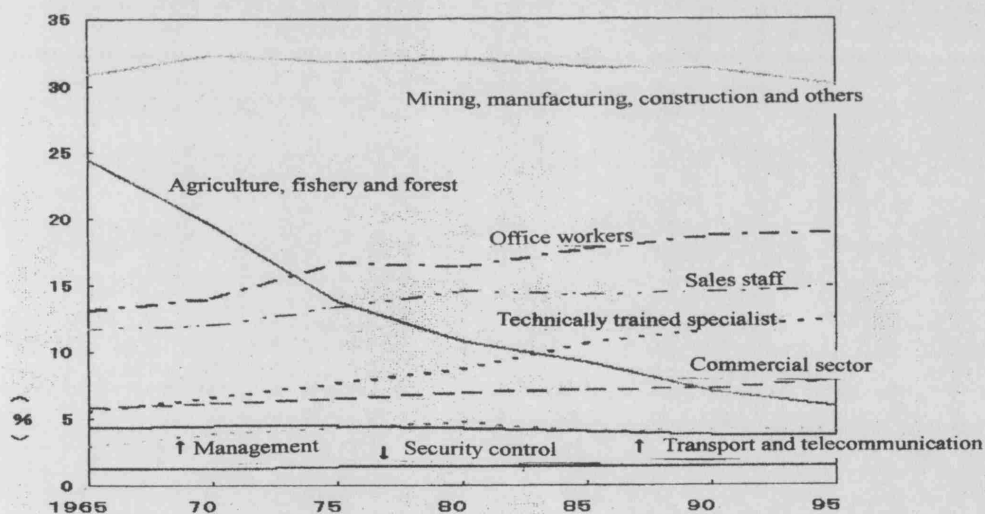
60.2% of the households own their property. The average accommodation size is 85.9 sq. m., with 115.4 sq. m. for private housing, and 37.9 sq. m. for the rented sector (MCA, 1996).

2.1.3 Economic Size and Occupational Structure

Japan's GDP was ¥ 505 trillion (about US\$ 4.6 trillion) in 1997 (MCA, 2000). As a result of the economic crisis during 1990s, the average GDP growth rate, which once was 4.1% during 1980s, is 1.2% between 1990 and 1998. The employment also suffers from the crisis, recording 5.4% unemployment rate in summer 2002, the highest in the post W.W.II period, though the situation is being gradually alleviated.

Japanese employment structure is experiencing a transition from the one which is dominated by the primary industries, to a more tertiary oriented one. For example, people who engaged in the primary industries were once 30% of the total workforce in the late 1960s, but shared only 6% in 1997. On the other hand, the tertiary industries continue steady increase as shown in Figure 2.2 (MCA, 1995).

Figure 2. 2: Japanese occupational structure



(Source: MCA, 1998)

2.1.4 Political Profile

The Japanese politics shows a remarkable single party dominance: The Liberal

Democratic Party (LDP) has been in the power most of the post World War II period, though its influence has been eroded after the 1990s. Especially in 1992, formation of new parties and the break-up of LDP itself took place, and the Japanese political scene became highly fluid. LDP was back in power by making a coalition with its rivals, including Japan Socialist Party (JSP). The coalitions have been, however, fairly short lived. LDP was lost in the upper house election in 1998, and the Prime Minister, Ryutaro Hashimoto resigned to take the blame. Since then, LDP managed to continue its rule by forming a coalition with parties such as the Komei Party and the Liberal Party. After Mr. Obuchi and Mr. Mori, Mr. Koizumi took the Prime Minister's position in April 2001. He was appealing to the Japanese public by advocating radical structural reform, but his popularity is waning as his political performances turned out to be rather cosmetic.

Japanese politics are known to be less potent than its administrative bureaucracy, which practically determines the government policies in most of the fields. This is largely a result of the single party dominance where bureaucrats can predict and produce necessary policy proposals. Against this background, politicians are generally perceived as irrelevant to significant policy change, and, the government bureaucracy provides "stability" to Japanese policy making.

Many observers, on the other hand, suggest that the Japanese politics is changing.

The declining influence of the existing election machines, such as the agrarian power, has started to show their effects (Curtis, 1999). The bureaucrats are also currently receiving harsh criticisms as a result of many signs of its corruption. It is, however, yet to be seen to which extent the observed "stability" and "stagnation" in Japanese politics and administration will be removed.

There are some signs that the politics will take the environmental demand into account, and some political parties and the members of the Parliament made pledges as to their devotion towards the environmental aspects of the energy issues. The "ancient regime", however, remains and resists any change. For example, many LDP Members of Parliament are generally representing the vested interests of the particular industrial sectors, notably the power generating industry, and behave to protect the industry's business interests. The opposition parties, on the other hand, seem not yet to co-ordinate sufficient policy integration to counter the LDP-industry allies. A further political rearrangement is seen to be necessary, if there were to be any significant political leadership for the energy and the environmental issues in Japan.

2.2 Energy Overview

2.2.1 Historical Background to Japanese Energy Issues

Japanese reliance on imported energy fuel does not have a long history. Japan had been relying on indigenous energy sources during its pre and early industrialisation periods. For example, in the feudal Edo period (16 to 19 century), Japan terminated most of the external relations with the fear for foreign colonisation threats, and it saw energy and material "self-sufficiency" for over 300 years. Even after the Meiji Reformation at the end of 19th century, when Japan started to introduce the Western industrialisation models to become an imperial power itself, the main energy came from indigenous sources, such as hydro power and domestic coal combustion.

The replacement of the hydro/coal energy with the imported oil is a development after the World War II, when hydro and coal lost its political and economic competitiveness to the imported oil: the US government recognised the crude oil as a strategic tool to control the degree of Japanese industrial recovery and its development, and actively promoted the use of imported oil to the Japanese industry. Under "US-Japan co-operation", Japan was also given an access to the

US market to gain foreign reserves, so that it can buy imported fuel. In exchange, Japan's strategic independence has been put under the US umbrella, providing the market to the US and other oil companies. The notable result of the combination of these give-and-takes was the increased Japanese crude oil import. In other words, the US policy to "fuel the growth of Japan" is one of the most important elements which determined the current political, economical and social formation of Japan (Hein, 1990). A number of former military bases were converted into petro-chemical industrial sites. It is not a coincident that many pollution-related health cases occurred in the vicinity of these sites, especially during 1950s and 1960s (Nihon Kagakusha Kaigi, 1980).

2.2.2 Current Energy Overview

Japanese total primary energy supply was 497.2 (Mtoe) in 1995, of which oil dominated by 54.2%. Over 99% of oil is imported, and the Middle-East oil accounted for 80% (Table 2.3). Oil dependency ratio was decreased from 1973 when it accounted for 77.9%, though it is still higher compared to other industrialised nations (IEA, 1999).

Table 2. 3: Total Primary Energy Supply Shares of Japan (%)

Total Primary Energy Supply Shares	1973	1990	1995	1996
Coal	17.9	16.9	16.6	16.6
Oil	77.9	57.6	54.2	53.6
Gas	1.6	9.9	10.5	11.0
Combination of Renewables & Waste	-	1.5	1.4	1.4
Nuclear	0.8	12.0	15.3	15.4
Hydro	1.8	1.8	1.4	1.4
Geothermal	0.1	0.3	0.6	0.7
Solar/Wind/Other	-	-	-	-
Electricity Trade	-	-	-	-

(Source: IEA, 1998a)

Of the energy produced, industry consumes nearly a half. This sector's consumption still decreased from 60% in 1973, and this decreasing trend is expected to continue, due to the adoption of a various energy efficient technologies and methods (Table 2.4).

Table 2. 4: Total energy consumption by sectors

(Mtoe)

	1973	1990	1995	1996
Total final consumption of energy	235.3	294.5	330.3	337.1
	100%	100%	100%	100%
Total industry	140.2	134.5	142.8	144.1
	59.6%	45.7%	43.2%	42.7%
Transport	43.4	74.3	86.9	90.0
	18.4%	25.2%	26.3%	26.7%
Total other sectors	51.6	85.7	100.6	102.9
	21.9%	29.1%	30.5%	30.5%

(IEA, 1998a)

Transport and residential/commercial consumption has increased to 26.7% and 30.5% respectively. Both of these figures nearly doubled since 1973. The Japanese government forecasts that transport share of consumption will be stabilised by 2010, though there is little evidence to support this prediction. Residential consumption is foreseen to be on a continuous growth path, as the Japanese residential lifestyle is currently experiencing a transition from the one which relies on a relatively modest use of energy to more energy intensive one which is supported by a number of domestic automation facilities. The greater use of air-conditioning, higher heating standards, and the electrical equipment which involves many gadgets increase residential/commercial energy demand. Energy consumption of commercial sector is also increasing due to greater electricity use.

The overall electrification rate is rising, with about 40% of the total primary energy consumption is used to generate electricity (Table 2.5).

Table 2. 5: Electrification rate (%)

	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Residential	34.3	34.8	36.1	38.1	38.8	38.3	37.8	40.7	39.8	40.3
Commercial	37.7	36.6	38.8	39.7	38.7	38.9	41.1	42.6	42.5	43.9
Industry	18.3	18.3	18.8	19.3	19.5	19.6	19.2	19.3	19.3	19.5
Transport	2.3	2.3	2.3	2.3	2.3	2.2	2.2	2.2	2.1	2.1
Average electrification rate	19.0	19.0	19.5	20.2	20.3	20.4	20.4	21.0	20.9	21.1
Electricity share in Primary energy	37.5	37.3	38.0	38.7	39.6	39.0	39.0	39.2	39.5	39.6

(Source: ANRE, 1998)

The number of registered vehicles increased from 27.8 million in 1975 to 72.8 million in 1997 (MCA, 2000), while the fuel efficiency has been decreased from 13.0 km/l in 1982 to 11.1 km/l in 1991 (Energy Efficiency Centre, 1999). Upon the introduction of the consumption tax in 1989, the former commodity tax, which used to charge higher rate for large-sized cars, was abolished (Grubb, 1991). The combination of these signals and Japanese consumer's preference for luxurious and large cars made the share of larger cars grow.

Table 2. 6: Vehicle Numbers in Japan (1997)

	Number	Share
Passenger cars	48,684,206	66.8%
Trucks	19,402,235	26.6%
Bus	239,866	0.3%
Special vehicles ¹	1,521,321	2.1%
Motorcycles	3,008,947	4.2%
Total	72,856,583	100%

(Source: MCA, 2000)

The energy consumption of freight transport sector also increased during 1990s, when the number of trucks grew from 10 million in 1975 to 19 million in 1997, with the background of cheap gasoline price. The government is intending to reduce fuel intensity of Japanese trucking by increasing maximum gross weight.

2.3 Responsible Organisations

The most important government organisation about energy issues is the Ministry of Economy, Trade and Industry (METI). It has a wide range of trade organisations under its umbrella, which allows METI to have extraordinary powers in terms of obtaining formal and informal forms of information and

¹ Special vehicles are the vehicles which have particular purposes such as agricultural or industrial uses.

co-operation from industry (See Appendix A for the organisational structure of the Japanese government). METI is particularly responsible for strategic industrial land use, including choice of power station siting locations.

METI has 4 main agencies, one of which is the Agency of Natural Resources and Energy (ANRE). This is in charge of issues related with electricity and mining industry (domestic coal/oil/gas development), as well as renewable energy development. The Agency of Industrial Science and Technology (AIST) is also under the METI's umbrella, which is a research institute for applied technology.

The Ministry of the Environment (MoE) is specifically in control for environmental pollution issues from industrial sites, including emissions from power stations. However, although it has a ministerial status, MoE has far less officer numbers than its rival organisations. The MoE's has less strong bargaining power over industries. This often forces it to compromise on national environmental policies.

For nuclear management, the Atomic Energy Commission (AEC) was established under the 1955 Atomic Energy Basic Law, and it oversees strategic planning of nuclear power development. The Nuclear Safety Commission was established by

the amendment of the Basic Law for matters related to nuclear safety. The establishment of the Safety Commission was to double check nuclear safety. However, the experience of the JCO accident in 1999 revealed inability of the Nuclear Safety Committee to respond correctly to an emergency situation (refer table 1.4 in Chapter 1). As a result, the Nuclear Disaster Prevention Law was enacted in December 1999 to establish a line of organisations (including national and local representatives) responsible for contingency actions, though critics argue that the creation of such organisations may remove the chance for the local authority to take early actions, causing delay by waiting to find out about the necessary institutional arrangements (Takahashi and Motoyama, 2000).

2.4 Financial Structure

2.4.1 Government Financial Structure for the Energy Issues

Appendix B exhibits the overall flow of energy budget. Majority of energy related budget is supported by taxes which are supplemented by other revenues.

There are several energy related accounts: Coal and Petroleum/Non-petroleum Alternative Energy Special Account (CPAESA), which is further divided into the Coal Special Account (CSA) and Petroleum/Petroleum Alternative Energy Special

Account (PPAESA), and Electric Power Resources Development Special Account (EPRDSA). Revenues from petroleum tax, crude/fuel oil import tax goes to CPAESA to fund coal subsidy (CSA), oil exploration/stockpiling, and energy efficiency improvement projects, as well as non-fossil fuel development (PPAESA).

Electric Power Resources Development Special Account (EPRDSA) is funded by Electric Power Resources Development Promotion Tax (¥ 0.445/kWh, equivalent to about US\$ 0.004/kWh), which is ultimately levied to electricity consumers. While about the half of the EPRDSA is intended to fund non-fossil energy R&D programmes, the latter half is often liquidated, during power-plant site acquisitions, to allow flexibility for negotiations with localities (Suttmeier, 1981). Overall, about 80% of EPRDSA is nuclear related, whereas merely 3% of the fund is allocated to the New Energy development (Iida, 1999) (Table 2.7).

Table 2. 7: EPRDSA Allocation in 1999

(Unit: million yen)

Power Siting Account		Fuel Diversification Account	
Grants to localities co-operating with thermal power plant construction	114.4	Studies on energy efficiency of power generation sector	13.2
Grants to localities co-operating with hydro power plant construction	6.4	Studies on energy efficiency of power transmission and energy consumption sector	21.3
Grants to localities co-operating with nuclear power plant construction	101.3	Nuclear and Renewable Energy Development	85.8
		Fund goes to STA	116.8
Others	4.1	Others	8.3
Sub total	226.2	Total	245.3
Total			471.5

(Source: ANRE, 1999)

2.4.2 Government R&D Expenditure

Japanese Government expenditure on energy R&D is estimated to be total ¥ 415 billion (US\$ 3.8 billion) per annum (1998) (IEA, 1999). Of which nuclear R&D dominates by over 70%. This is a clear indicator of Japanese government commitment for nuclear energy, though the budget on R&D related to nuclear, as well as to fossil fuel, has been reduced over the recent 3 years, pushing the total budget for energy R&D downward accordingly.

On the other hand, the budget for energy conservation is on the rise. Renewable energy R&D shares only about 3% of total energy R&D expenditure. Of the renewable, ocean power² is the only field which saw a significant budget increase, while the budgets for others such as wind, biomass, geothermal shares decreased over the recent 3 years (Table 2.8).

Table 2. 8: Government energy research and development expenditure (million yen)

	1996	1997	1998	% of 1998 total
Conservation	34,035	33,220	37,673	9.1
Fossil fuels	41,636	38,381	36,363	8.8
Oil and Gas	16,341	15,892	14,474	
Coal	25,295	22,489	21,889	
Renewables	13,253	13,194	13,781	3.3
Solar	8,103	8,174	8,311	
Wind	607	555	477	
Ocean	147	187	1,141	
Biomass	593	586	580	
Geothermal	3,803	3,692	3,272	
Nuclear	346,989	329,026	305,935	73.5
Nuclear fission	306,938	291,571	274,753	
Nuclear fusion	40,051	37,455	30,182	
Power and Storage Technologies	8,763	9,040	8,431	2
Energy system analysis	1,563	1,800	1,774	0.4
Other	12,743	12,900	12,186	2.9
Total	459,096	437,681	415,369	

(Source: IEA, 1999)

² Ocean power refers to wave power and thermal energy conversion using the sea water.

As for alternative energy, Japanese government has taken up R&D programmes since after the oil crisis. A set of R&D programmes, called the Sunshine Project, were started in 1974 to develop new energy technologies. The Moonlight Project, a sister programme of the Sunshine Project, was mainly looking at energy conservation technologies, started in 1978. There was another project which was to develop technologies for global environmental protection. Those three programmes were integrated into the New Sunshine Programme started in 1993. The budget for the New Sunshine Programme was ¥ 58 million (US\$527,000) in 1998 to fund technologies such as photovoltaic power generation, fuel cells, coal liquidation and geothermal utilisation (ANRE, 1999).

2.4.3 Non-government Energy R&D Expenditure

The Federation of Electric Power Companies (FEPC) and the Central Electric Power Council (CEPC) established the R&D strategy and the financial allocation each year, based on the priority given by the electricity companies. The total amount that the electricity companies contribute to the CEPC programmes is estimated to be about ¥ 28.8 billion (US\$ 260 million) in the year 2000³. Nuclear

³ This includes the R&D expenditure and the staff costs related to the programmes. The government also contribute to the CEPC, with the contribution of ¥ 4.4 billion (US\$ 40 million) in

research accounted for one third of the R&D budget, another third goes to fund electricity transmission and storage, and the rest to be allocated to the research on fossil fuel power generation, renewable resources development and environmental impact assessment techniques, etc. (IEA, 1999). In addition, Japan National Oil Corporation, a government owned company, carries out research as to oil/gas development.

2.5 Energy Industry

2.5.1 Electricity

Since 1990s to the first decade of 21 century, Japanese energy industry is going through a major reorganisation, as part of the national economic structural reformation. The old regime, however, had been operating most of the post W.W.II period, and it is worth reviewing the energy industrial structure prior to the present change.

Under the Electric Utility Industries Law, there were three different categories for electricity utility supply business (EUSBs). General EUSBs are privately owned

the year 2000.

companies. Wholesale EUSBs are a combination of nuclear generators and local government-own generators (through electricity generation by waste incineration). They have a permission to sell electricity to general EUSBs. Special EUSBs are autoproducers, mainly consisted with steel manufactures, oil refineries, etc.

There are 10 general EUSBs, most of them are operating since 1951⁴. Although the general EUSBs are private companies, they were vertically integrated, covering mutually exclusive supply areas. They are given a duty to supply electricity within each designated area (Section 18, the Electric Utilities Law). Entry into a sector was restricted by METI so that supply and demand are matched. In other words, the general EUSBs were the local monopolies, with the competition within and outside a supply boundary were tightly regulated before the electricity market reform. Greater efficiency might be gained through further encouragement of competition among the EUSBs, though careful consideration is required to optimise environmental benefits as well as the market and resource efficiency through such an inter-utility trade and competition (Table 2.9).

⁴ Okinawa Electricity was established in 1972.

Table 2. 9: General Electric Utility Sales, 1997

	Customers ('000)	Installed capacity (MW)	Electricity sales (GWh)
Hokkaido	3,579	5,431	25,802
Tohoku	7,219	12,437	66,330
Tokyo	25,285	53,975	263,250
Chubu	9,525	29,274	115,580
Hokuriku	1,869	5,509	24,151
Kansai	12,157	37,051	137,847
Chugoku	4,869	10,936	56,853
Shikoku	2,690	6,314	24,961
Kyushu	7,700	16,983	75,537
Okinawa	688	1,434	6,006
Total	75,610	179,515	794,318

(Source: The Federation of Electric Power Companies, 1997)

Wholesale EUSBs were quasi-government power companies, called Electric Power Development Co., Ltd. (EPDC), and Japan Atomic Power Company (JAPC), which are funded by the general EUSBs. EPDC supplies hydro-powered electricity, while JAPC do so with the capacity of 2,617 MW nuclear electricity to general EUSBs.

2.5.2 Electricity Market Reform

In December 1995, the Electric Utilities Law was amended to allow entry of independent power producers (IPPs). The transmission networks are also made accessible by third parties. In order to enable price competition, a new electricity

pricing system, called "yardstick method" was introduced to establish new accounting systems.

In addition, there is a new obligation for the general EUSB to tender any additional thermal power requirements expected to arise for the coming 7 years.

The effect of the 1995 amendment was observed as influential, as 100 IPPs applied with the capacity of total 10.8 million kW outputs, which was four times more than the volume required. 20 IPPs were chosen out of the 100 IPPs, with the capacity of 3 MWh. The average prices were about 35% lower than the utility thermal electricity net price (Saishu, 1997), which accounts for over 6% of the total utility electricity generation capacity. There are many more companies which have not entered the electricity market, but are identified to have generation potentials. Also, power producer and supplier (PPSs) are now allowed to do the wholesale business with large-scale customers (over 2 MW maximum demands) after the 2000 market deregulation.

The main IPPs were steel and petroleum refining industries which are already autoproducers of electricity, and their entry to the market was expected. There are 36 successful IPPs so far, mainly oil-fired and coal fired generators, and only 5 are gas-fired generators (Table 2.10). 1 special EUSB was created to supply to

specific customers. (Suwa Energy Service Company, established in 1997, with 3MW capacity.) The increased share of coal and oil fired IPPs is creating an environmental concern, especially in the form of atmospheric emission increase (IEA, 1999). The Ministry of the Environment is coping with the situation mainly by requesting tighter pollution control to IPPs.

Table 2. 10: Independent Power Producers by fuel

	Number of projects	Capacity (MW)	Share (%)
Coal	13	2,844	46
Oil	17	2,425	39
Gas	5	842	14
Other	1	55	1
Total	36	6,165	100

(Source: IEA 1999)

2.5.3 Pricing

Under the Electric Utility Industries Law, the pricing mechanism of electricity was regulated. For example, the standard tariffs and conditions of supply for EUSBs required approval from the government⁵. Electricity prices in Japan are comparatively high among the IEA countries. The reason for this is explained by

⁵ The government was able to impose tariffs and conditions when general EUSB and special EUSB do not meet an agreement.

the level of technological sophistication required for environmental standards, as well as market inefficiency (IEA, 1999). Customs duty on oil (which is for coal subsidy) and EPDRSA (which is to charge ¥0.445/kWh (US\$0.004/kWh)) to utilities, also lead to higher oil prices.

Though Japanese electricity prices are high, they are not the highest when different measurements are used for calculation. The figure 2.3 and 2.4 compares electricity price of the IEA member countries by using exchange rates and purchasing power parities (PPPs)⁶. It shows that Japanese electricity price is rather cheaper than some of the countries, when calculated in PPPs.

⁶ The data is taken from IEA 1998b.

Figure 2. 3: Electricity price of IEA countries

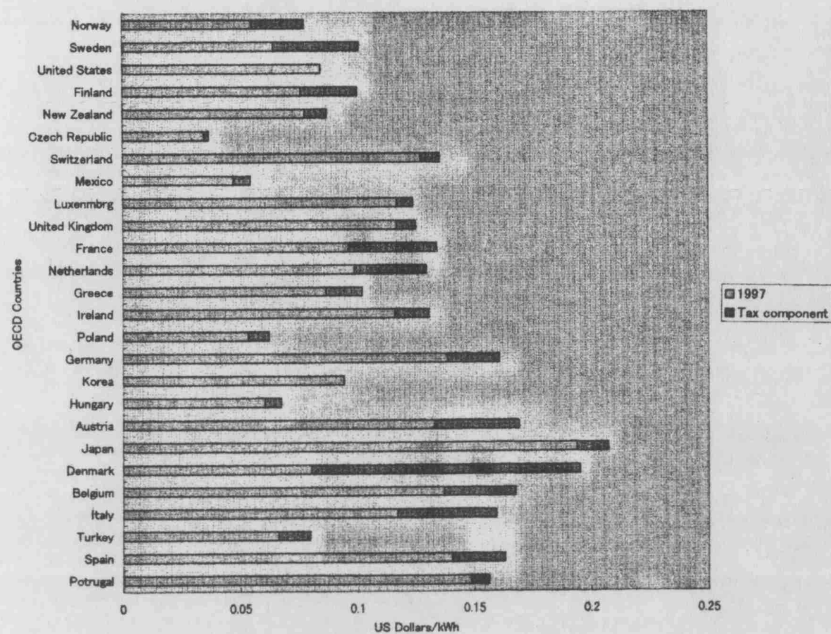
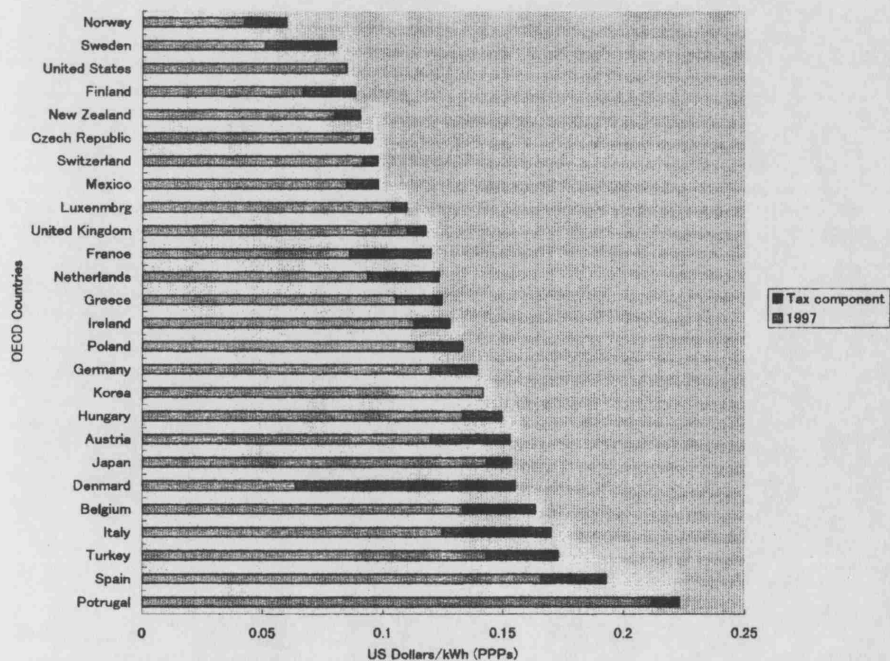


Figure 2. 4: Electricity price of IEA countries (using PPPs)



Things are, therefore, not quite as simple as is suggested by figures calculated by exchange rate, and careful examination is needed to determine whether Japanese electricity is the most expensive⁷. For example, many have argued that Japanese electricity price is really the highest, so that the introduction of even higher prices would be unthinkable, especially from a consumer protection perspective. However, as emphasised above, the electricity price is not as expensive as other commodities in Japan in real terms. A possibility of introducing higher tax to encourage energy efficiency cannot be rejected.

2.5.4 Oil

On the oil exploration and production side, there are 37 companies which import oil to Japan. As a response to the oil crisis, the Japanese government has been keen to develop direct relations with the oil producers, by establishing heavily subsidised state-run oil exploration companies. It is reported that these companies are in deep financial trouble to the extent that the government liquidated some of them, including the Japan National Oil Company (JNOC). Private-owned oil

⁷ In 1990, Taylor has pointed out that the UK's Department of Energy have failed to use Purchasing Power Parity for its study on Japanese pricing, distorting the relative level of Japanese and UK prices (Taylor, 1990).

development companies are also having a difficult time. For example, the Arabian Oil Company, established in 1958, failed to continue its concession with Saudi Arabia, on the company's refusal to co-operate on an Arabian railway construction project (Nikkei, 2000c).

On the distribution and marketing side, there are 38 refineries with 13 major oil wholesalers in Japan, which are the combinations of foreign and domestic capital investment. The major international oil companies made access to the Japanese market through business partnerships with Japanese companies. Petroleum products are distributed directly to large consumers and to dealers. Entrance to the gasoline retail business was regulated so that excessive competition was avoided. As a result, there were about 60,000 service stations in Japan, and the number has been stable for decades. However, in 1996 petroleum product import was liberalised, and restrictions were simplified. As the market entrance is relaxed, the service stations faced with an intensified price competition, lower margins and threats of closure. Also, the self-service petrol stations are made available, making employment redundancy out of the conventional "full-service" stations (IEA, 1999). The total number of petrol stations was reduced by 8% between 1996 to 2002 (Mainichi, 2002).

As the petro-product import was liberalised in 1996, the price level has been decreasing by 20% between 1996 to 2002 (*ibid.*). The price reduction was largely due to the fact that the oil distribution companies cut the net petrol price before the taxation prior to the competition. 60% of the fuel price is the tax component. It is higher than in the US (36.1%), but less compared to Germany (76.8%) and Denmark (73.0%) (IEA, 1998b).

2.5.5 Gas

Japan has a substantial amount of proven natural gas reserves. Domestic production, however, is minimal (2.3 Mt), despite a various financial and other incentives offered by the government (US DOE, 1999). Japan is the largest LNG importer in the world, importing 49.79 Mt in 1998, about 60% of the total world trade (EDMC, 2000, IEA, 1999). About 70% of the total LNG import is used for power generation, which is followed by residential/commercial uses (30%) and industrial use (1.3%) (EDMC, 2000). The main import sources include Indonesia, Malaysia, Australia, Brunei, the United Arab Emirates, the US, and Qatar. Other Middle East countries, such as Oman, Yemen and Saudi Arabia are also keen to develop their markets in Japan.

Japanese gas distribution is characterised with its small degree of gas distribution network availability. Only about 5% of Japan's total area has a gas distribution system, covering 21% of the urban area.

Four major companies (Tokyo Gas, Osaka Gas, Chubu Gas and Saibu Gas) dominate urban gas distribution. Those major companies alone share over 75% of the total sales volume. These gas companies carry out a majority of LNG imports. There are also about 240 smaller private and public gas operators (Table 2.11).

Table 2. 11: Number of Japanese Gas Distributors

	Total	Private operators	Public operators	Customer number total
Hokkaido	12	9	3	908
Tohoku	40	28	12	819
Kanto	114	75	39	11,176
Chubu	15	13	2	2,316
Kinki	19	10	9	6,115
Shikoku	2	1	1	253
Kyushu/Okinawa	29	26	3	
Total	244	173	71	24,087

(Source: Saishu 1997)

The government is keen to promote LNG in place to LPG, mainly because of environmental reasons. Since the caloric value is different between LPG and LNG, the major companies have invested heavily to convert their customer's LPG

facilities to enable LNG use. For example, Tokyo Gas took 15 years with ¥ 240 billion (US\$2.2 billion) to complete the conversion. Smaller scale operators, on the other hand, do not possess sufficient financial resources to adapt to the policy change. The government has started a financial support scheme (the Integrated Gas Family 21 initiative, since 1994) to help their conversion.

LNG price has been comparatively stable because of the long-term nature of LNG contracts. Short-term contracts, however, are on the increase, accounting for 7% of the total LNG imports. Overall, gas prices are about 3-4 times expensive in Japan than in the Western countries. Critics suggest the absence of gas distribution system as the main reason behind the higher retail gas price (IEA, 1999).

The gas industry mechanism was similar to the electricity industrial structure, where gas companies were given mutually exclusive supply areas, with the duty to supply gas to any customers in their boundaries. The gas industry, however, is also experiencing a major market reformation. For example, entry to the market was liberalised in 1995⁸, to allow large scale consumers (above 2 million cubic meters annual consumption) to negotiate prices directly with gas utilities outside of the existing supply areas. Mixtures of gas and non-gas companies are wishing

⁸ It is due to the 1994 amendment to the Gas Utilities Law, which came to effect in March 1995.

to enter the market, such as Teikoku Sekiyu, Sekiyu Shigenkaiatsu, Tohoku Tennen Gas and Shin Nippon Steel (Saishu, 1997).

Another major change is the liberalisation of the gas distribution system. In 1996, third party access was allowed to the gas networks owned by the gas companies. So far, however, only a few companies use the gas networks. Example includes: Shin Nippon Seitetsu through Saibu Gas network, Kansai Electricity through Osaka Gas network.

International pipeline projects are under consideration, to connect Sakhalin, China, Russia and the Middle East. Domestic pipeline construction is facing financial difficulties, mainly because of high property costs involved in land acquisition.

2.5.6 Coal

Japan is the largest importer of steam (64.1Mt) and coking coal (65.3Mt) in the world, accounting about 28% of the total world coal imports (US DOE, 1999). 60% of the imported coal is used for power generation, and the rest to be for paper pulp, cement, and steel manufacturing. Japan maintains a relatively stable supply

of coal from Australia, South Africa, and the US. Also, the imports from China and Indonesia are increasing sharply.

Domestic coal production, which used to record 55Mt in the early 1960s, lost its competitiveness, accounting for only 4Mt in 1997. The domestic coal price is three times higher than the imported coal, but the production was maintained to keep regional employment and to continue domestic coal R&D.

There was an import quota system in which utilities were required to buy a certain amount of domestic coal as a condition of importing foreign coal. The import quota system, however, was abolished in 1992. There have also been subsidies which are mainly required to pay compensations to redundant workers and to regenerate the local economy. The government ended the whole subsidy at the end of March 2002.

The future of Japanese coal imports are poised between the government CO₂ reduction policy and domestic demand. Steam coal consumption for power generation is expected to increase at a rate of 0.7% until 2010 (US DOE, 1999).

On the other hand, demand for coking coal is reduced because of the Japan's economic slump, as well as the improved technological efficiency.

2.5.7 Nuclear

Japan's nuclear output accounts for 44GW in 1997 which was on a steady increase since 1973 when the output was only 1.8GW. The increased rate is far higher than the average world growth rate.

Currently, nuclear supplies a third of the total power requirement and 10% of primary energy supply in Japan (Table 2.12) (IEA, 1999). Of the total installation, the Pressurised Water Reactors (PWRs) are operated by Kansai Electricity, Kyushu Electricity, Shikoku Electricity and Hokkaido Electricity, whereas Tokyo Electricity, Tohoku Electricity and Chugoku Electricity own Boiling Water Reactors (BWRs). Tokyo Electricity also operates two Advanced Boiling Water Reactors (ABWR) (Table 2.13).

Table 2. 12: Nuclear installation and capacity growth in Japan and the World

	Japan		World	
	Installation	Capacity	Installation	Capacity
1973	5	1.8GW	147	50GW
1997	51	44GW	432	360GW
Growth rate between 1973 and 1997	10.2%	24.4%	2.9%	7.2%

(Source: Saishu, 1997)

Nuclear power is regarded as a suitable option to energy security. It is also taken to fit to the national policy to reduce CO2 emissions. With these backgrounds, the government intends to increase nuclear capacity by 42% in 2010, suggesting that an additional 16 to 20 new nuclear reactors are required.

Table 2. 13: Nuclear installations in Japan (number of installations)

	PWR		BWR		ABWR and others	
	In operation	Under construction/ planned	In operation	Under construction/ planned	In operation	Under construction/ planned
Hokkaido	2	0	0	0	0	0
Tohoku	0	0	2	3	0	0
Tokyo	0	0	15	0	2	0
Chubu	0	0	4	0	0	1
Hokuriku	0	0	1	0	0	1
Kansai	11	0	0	0	0	0
Chugoku	0	0	2	0	0	0
Shikoku	3	0	0	0	0	0
Kyushu	6	0	0	0	0	0
JNFL	1	0	2	0	0	0
Total	23	0	26	3	2	2

(Source: FEPC, 1999)

The Japanese government sees uranium and plutonium recovery as a measure to enhance the national energy security and to reduce the excessive generation of plutonium and radioactive waste⁹. Japan Nuclear Cycle Development Institute (JNC), a public corporation under the METI umbrella, has a reprocessing facility in Tokai-mura¹⁰, while Japan Nuclear Fuel Ltd. (JNFL) operates a uranium enrichment facility and a low-level radioactive waste disposal facility in Rokkasho-mura. There is one planned large scale reprocessing facility in Rokkasho-mura, which is due to start operation in 2005.

The Japanese government is keen to consume ever-increasing plutonium produced through power generation. It had a plan to construct fast breeder reactors to recycle plutonium. The flagship of the project was the Monju Reactor operated by Japan Nuclear Cycle Development Institute (JNC). However, the reactor became out of operation after a sodium leakage accident in 1995. The combustion of mixed-oxide fuel, a combination of plutonium and uranium, in the conventional PWRs became the focal technology as an alternative way to utilise plutonium.

⁹ Japanese plutonium stock was about 20 metric tonnes in 1996, which is now estimated to be about 30 metric tonnes (Albreit, et. al., 1997).

¹⁰ JNC succeeded the Power Reactor and Nuclear Fuel Development Corporation, which was disbanded after the Monju Accident in 1995.

Fukushima Daiichi (Fukushima Prefecture) owned by Tokyo Electric Company and Takahama (Fukui Prefecture) of Kansai Electricity have been chosen for this project, which was supposed to be followed by other sites such as Kashiwazaki in Niigata Prefecture.

In September 1999, falsified information was found as to the MOX fuel imported by Kansai Electricity from British Nuclear Fuel Limited (BNFL) (ENDS, 1999). The whole MOX projects were accordingly suspended, whereas the BNFL lost the business trust of Japan and other countries (Independent, 2000)¹¹.

The Japanese public recognises the importance of energy security, and nuclear was generally regarded as a necessity. The recent sequences of nuclear incidents, which have been often followed by stories of secrecy, seriously erode the public trust. The government opinion poll demonstrated a majority (67%) of the Japanese nationals showed their preference for more benign forms of energy sources, such as solar or wind power, whereas people who supported further nuclear

¹¹ The BNFL is also accused by the international community on the ground of their nuclear polluted water discharged into the Irish Sea. The Irish and Danish governments are leading the campaign for the termination of BNFL by bringing the plant closure proposal to OSPAR, an international agreement on marine pollution. The meeting took place in Copenhagen in June 2000 which raised a serious question on the continuation of BNFL.

development remained less than 15% (Cabinet Office, 1999). The opinion poll was carried out before the JCO accident, which seriously undermined the public confidence on the whole nuclear business. It means the actual number of people who support the nuclear option after the JCO accident may be significantly less than the observed number.

Utilities are increasingly uncertain about the nuclear future, which requires considerable state intervention. The government financial injection is getting difficult as a result of market reorganisation. The utilities are, therefore, trying to reduce its cost, mostly by cutting the cost of nuclear operation, or by switching to other energy sources, such as LNG.

2.2.5.7 New Energy

Renewable energy, which is not yet economically viable, is defined as "New Energy" in Japan. Solar, wind, waste combustion are New Energy fuels, but hydro and geothermal powers are currently commercially developed, and are not included. The government established the target to introduce 3.1% new energies in the total energy by 2010, as compared with 1.1% in 1999. Of all the new energies, combustion of black liqueur and bark produced in paper manufacturing

and municipal waste dominate, while genuine non-fossil sources, such as solar and wind, contribute little (Table 2.14).

Table 2. 14: New Energy Supply

(Unit: 1000 kl. toe)

	1996	2010 (Estimated)
Photovoltaic power generation	14	1,220
Solar heat utilisation	1,040	4,500
Wind power generation	6	120
Municipal waste power generation	820	6,620
Municipal waste heat utilisation	44	140
Thermal energy conversion	33	580
Biofuels power generation (black liquor, bark produced in paper manufacture)	4,900	5,920
New Energy Total (Share in Total Primary Energy Supply)	6,850 (1.1%)	19,100 (3.1%)
Hydro	20,300 (3.4%)	23,410 (3.8%)
Geothermal	1,200 (0.2%)	3,800 (0.6%)
Renewable Energy Total (Share in Total Primary Energy Supply)	28350 (4.7%)	46,310 (7.5%)
Total	597,000	616,000

(Source: ANRE, 1999)

To encourage New Energy development, the New Energy Promotion Law was enacted in June 1997 to set a framework to support such energy development. It establishes mechanisms to provide financial support to New Energy users. Also, ¥ 74.8 billion (US\$ 680 million) was allocated for their promotion, which is

supplemented by some national and local financial support. The New Energy and Industrial Technology Development Organisation (NEDO), and the New Energy Foundation (NEF) are to provide financial and technical support for the New Energy technology dissemination.

Although over the half (58%) of the wind power generators are operated by the general EUSBs (NEF, 1999), there are an increasing number of individual operators which started to sell wind and other New Energy power, such as Yamagata Wind Power Institute (Yamagata Prefecture) and Erimo Wind Power Institute (Hokkaido).

For solar power, there is a scheme to fund individual solar electricity generator installation since 1992. ¥ 10 billion (US\$ 90 million) has been allocated between 1996 and 1998, and the total generation capacity reached to 20,529 kW in 1995 (NEF, 1999).

Critics, however, argue the lack of strategic consideration to the allocation of these funds, pointing out that the majority of the solar fund has been deferred every year, while fund for wind power installation is scarce. Also, wholesale terms and conditions, including the prices, are mainly decided by the general EUSBs, creating uncertainty to the individual operators (Iida, 1999).

Upon consideration of these inefficiencies, as well as the experience mainly of Germany, Denmark and Spain, a new law was proposed to the Parliament, to impose the general EUSBs the electricity purchase obligation from individual solar and wind power generators (generally known as the “Feed-in Tariff” system). The proposal recommends allocating EPRDSA to the New Energy purchase obligation, so that the cost of the new rule does not lead to additional electricity price increases to end customers. It is suggested that a few billion yen out of ¥ 450 billion (US\$ 4.1 billion) of the total EPRDSA, could theoretically be used to purchase electricity produced by all the renewable energy generation facilities in Japan (*Ibid.*). In order to catalyse the potential of the EPRDSA reformation, there must be sufficient incentive for the utilities to purchase the renewable power. For example, as will be discussed later, carbon tax may play an important role in determining the level of reward to the utilities.

The proposal was, however, quashed as the government made an act in 2002 (the Act of Special Arrangement Regarding Electricity Companies Use of New Energy), known as the Renewable Portfolio Standard (RPS) Law. The RPS Law is to request electricity companies to make sure a certain share of the electricity they supply is generated through renewable sources. The prescribed share in 2003 was

about 1% of the total sales of each electricity company. Critics doubt the effectiveness of the RPS Law in terms of renewable energy development, compared to the Feed-in Tariff system.

Further development is the Framework Law on Energy, which was approved by the Parliament on June 2002. Critics argued that the original intention of the drafting of the law was to firmly place nuclear energy into the core of the national energy policy, as well as to protect the domestic energy industry from competition involving foreign participants (Suwa, 2001).

Through observation of these legislative trends, the government policy towards renewable energy appears rather cosmetic, while their determination to support nuclear energy is firmly materialised in the various forms of acts and regulations.

2.6 Priority

2.6.1 Global Warming Context

There is an increasing amount of evidence suggesting the energy related fossil fuel combustion and its associated CO₂ emission result in the global climate

change, which could have significant implications for the survival of the current biosphere as a whole.

The international recognition over the dangers associated with CO₂ emissions led to the signatory of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) in December 1997. The Protocol establishes limits on the emissions of six greenhouse gases (CO₂, CH₄, N₂O, HFCs, PFCs, and SF₆) from industrialised countries. These countries, as a group, have agreed to reduce their average annual emissions in the 2008 to 2012 period by 5 per cent below the 1990 levels. Within this average, Japan is given an allocation to reduce its emissions by 6% below the 1990 levels.

Japanese government has formulated several policies to meet the requirement. The Long-term Energy Supply and Demand Forecast is a key document to exhibit the agendas and programmes for the government energy strategy.

2.6.2 The Energy Supply and Demand Forecast

The Long-term Energy Supply-Demand Forecast (LTEF) (1998) was originally presented in 1994, then revised in 1998, to represent the overall government priorities and energy forecast to 2010. In this sections, this will be detailed¹².

2.6.2.1 Supply side

The Forecast identifies the nuclear as a dominant energy source, at least, for the foreseeable future. Nuclear is regarded as having advantages in terms of economic and energy security perspectives. Also, the Forecast sees uranium is scarce, hence, nuclear fuel reprocessing is deemed as necessary. It urges further nuclear introduction through:

- information dissemination as to nuclear necessity and safety;
- use of financial incentives to local persuasion, with greater flexibility given to EPRDSA;

¹² In July 2001, the LTEF was reviewed, and some modification was made to reflect the reality, e.g. energy demand increase. But the overall framework for future action is not affected. More detailed discussion on LTEF is in the Chapter 6.

- establishment of nuclear waste management system, and nuclear decommissioning system for older facilities.

The Forecast also recognises renewable energies as potentially important options for a longer time scale. The less priority, however, is given to them because of their weaker market competitiveness. The Forecast identifies cost reduction and stronger market competitiveness, as the major challenges for the renewable energies.

Although fossil fuels are disadvantageous in terms of energy security and of their potential to the global warming, there are limitations to reduce their shares in the national energy supply. For oil and its associated fuel, such as LPG, the Forecast recommends further continuation of diversification and stockpiling policies. In addition, the current energy market reformation is regarded as a part of strategies to establish stronger connections with foreign capitals, to ensure securer fuel supplies from them in case of contingency.

Japan has been progressively relying on imported coal and LNG. The international co-operation for their resource development, as well as the relevant technology transfer, is prioritised by the Forecast. The demand for these fuels from the entire

Asian region is increasing, notably from Korea and Taiwan, and Japanese financial engagement is hoped to help sustain its bargaining power better than those rival countries.

2.6.2.2 Demand Side

The Forecast recognises the actions that need to be taken for industry and domestic/transport sector. It is acknowledged that, although the energy efficiency of the industrial sector in Japan ranks highest in the world, the degree of efficiency has recently stagnated. Rationalisation of energy use is required, particularly for the small and medium sized factories. Development and diffusion of New Energy conservation technologies are also identified as necessary.

For domestic and transport sector, control of energy demand, through technological and economic measures, is regarded as a priority. Introduction of "top-runner" method, which sets efficiency standards just above the highest performance standard currently reached, to improve vehicle fuel efficiency and standards for household electrical appliances is an example of such measures. Housing structure is regarded as contributing to the air conditioning demand, thus

tightening of construction standards, such as insulation requirements, is seen as important.

Also, the construction of new roads, as well as the introduction of sophisticated road traffic systems to reduce traffic congestion, is expected to help energy conservation. The development of clean energy vehicles is further encouraged.

For the reduction of domestic/transport energy requirement, the "lifestyle alternation" is regarded as necessary to influence overall energy consumption level. Currently, the argument is mostly epitomised by the issues such as daylight saving time introduction, promotion of safe and appropriate use of bicycles, and persuasion of people to cut unnecessary car use.

Strengthening research and development of innovative environmental and energy technologies are required. The Forecast considers improvement of infrastructure can ensure these innovative technologies to be better supported. For example, the introduction of clean energy vehicles will be encouraged by arrangement of necessary logistics, such as new fuel supply systems. Reduction of physical transport could be also enabled through further development of the telecommunications environment. According to the Forecast's view, the development of the road structure is also recognised as a key to traffic efficiency,

hence, energy consumption reduction. Experiences have demonstrated that providing road does not necessarily lead to traffic/energy efficiency: experience and research demonstrate that the more roads, the more cars¹³. The Forecast, therefore, might be misleading traffic management policy.

The table 2.15 demonstrates the energy reduction targets through a various policies.

¹³ For example, the correlation has been established between the increase of British trunk road programme and the congestion level.(UK DoT, 1994, British Road Federation, 1994)

Table 2. 15: Energy consumption reduction targets

	Segment	Target (million kl. oil equivalent)	Measures
Industry	Large scale factories	18.1	Through voluntary actions for technological and other energy efficiency
	Smaller scale factories	1.5	Through revision of the Energy Efficiency Law to require development of energy efficiency plan.
	Technology Development	1.4	Mainly focusing on technological developments which are feasible by 2010.
Industry total		21.0	
Domestic	Household electrical appliance standard	4.5	Introduction of "top-runner" method, which sets efficiency standards just above the highest performance standard currently reached.
	Housing structure	8.7	Improvement of insulation through tightening of standards, arrangement of financial incentives and other supportive mechanisms.
	Technological R&D	1.1	Mainly focusing on technological developments which are feasible by 2010, such as energy efficient computer display and lighting appliances.
	"Life-style" change	3.1	Appropriate level of energy consumption through e.g. temperature adjustment of air conditioning.
Domestic total		17.4	
Transport	Vehicle standard	4.5	Introduce "top-runner" method to raise the efficiency standards.
	Types of vehicle	0.8	Introduction of clean energy vehicles, using fuels such as electricity, methane, or hybrid systems.
	Non-vehicle transport efficiency	0.8	Improve energy efficiency of non-vehicle types of transport unit, such as railway, ship and aeroplane.
	Technological R&D	0.4	Develop new type of clean energy vehicle
	Transport system efficiency	7.4	Improve efficiency through commercial and non-commercial transport management. The management strategies include encouragement of public transport use and traffic congestion easing, and increased loads for commercial vehicles.
	Telecommuting	1.5	Through encouraging information technology development.
	Modal change	1.9	Shift from car use to less energy intensive modes, such as bicycle and walking.
Transport total		17.3	
Total		55.7	

(Source: ANRE, 1999)

2.6.2.3 Long-term Targets

Although the UNFCCC agreement is a significant step forward, this is a rather modest if more long-term reduction requirement is considered. The atmospheric CO₂ concentration is estimated to be about 200 to 280 ppmv for over 400,000 years. Even after the human being started to use fire, the CO₂ concentration in the pre-industrial period has long remained to be about 280 ppmv. On the contrary, the concentration has been growing significantly, to the current level of about 370 ppmv after the industrial revolution.

The Intergovernmental Panel on Climate Change (IPCC), a technical research body established by the United Nations, has issued a Second Assessment in which it argues that the CO₂ concentration is required to be reduced to the 450 to 550 ppmv level by the year 2200 to 2300 to minimise the global temperature increase (IPCC, 1995)¹⁴. This roughly suggests that, by the year 2100, the global CO₂ concentration has to be reduced at least to one third of the current level (Figure 2.5 and 2.6).

¹⁴ IPCC is conducting a further study on the CO₂ emissions and its effects on the climate change. It published the Third Assessment in 2001.

Some European countries are on the way to integrate these figures into their national reduction targets. For example, the Royal Commission on Environmental Pollution in the UK has proposed that 550 ppmv, which is double the volume of the pre-industrial level, should be regarded as the maximum limit of the world CO₂ concentration. The RCEP has specified the 60% reduction of the CO₂ by 2050, and 80% by 2100 from the current annual emission as desirable (RCEP, 2000). Also, the Danish government has formulated programmes to achieve 450 ppmv world CO₂ concentration in its national energy policy (Danish Ministry of Environment and Energy, 1996).

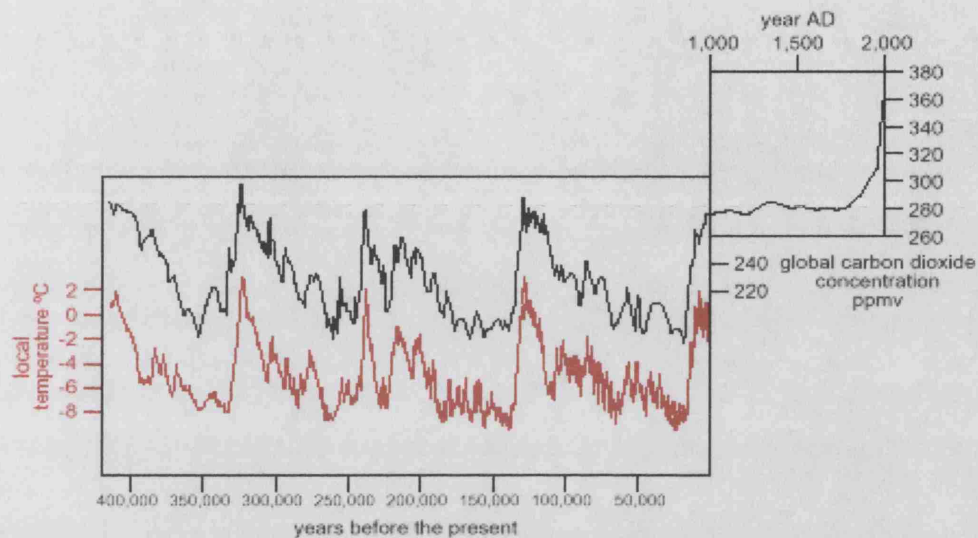
The Japanese Government has, however, not produced any credible account as to the degree of required CO₂ reduction beyond the targets specified by the Kyoto agreement¹⁵. The Forecast, the Japanese government response to the UNFCCC agreement, is looking at the energy supply-demand agenda for about 10 to 15 years, which is fairly short period considering the time scale required to stabilise the global climate change.

¹⁵ There are some academic arguments on the issue of long-term CO₂ stabilisation targets. For example, Wada proposes a 90% CO₂ reduction by 2100, in order to achieve the 450 ppmv concentration (Wada, 1999).

In 1996, Japan's CO₂ emission volume was 1,061.8 MtCO₂, while the CO₂ *per capita* was 9.31tCO₂. The world average CO₂ emission *per capita* was 4.14tCO₂, which is significantly lower than the Japanese level, meaning that Japan has to face a considerable challenge to reduce its emission. In fact, in order to reduce the CO₂ emission to one third of the current level by the year 2100, the world average has to be about 1.4tCO₂. This suggests that Japan must achieve the about 85% reduction from the 1996 level.

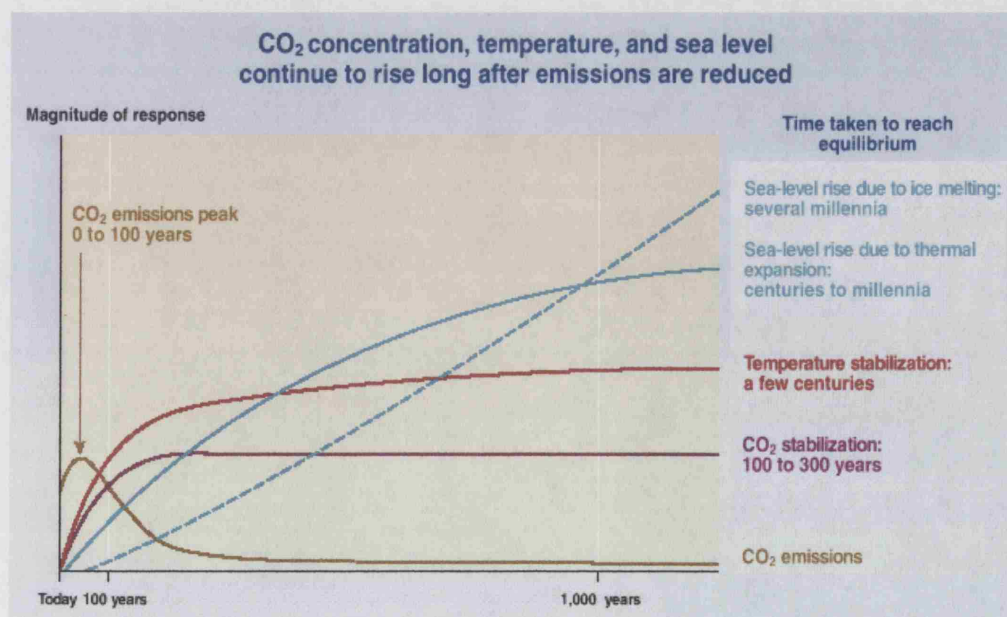
This is an enormous challenge, requiring not just the long-term strategy up to 2100, but also the short-term (covering 10 to 15 years) and medium-term (possibly covering a few decades) programmes to ensure target achievement. Given the scale of the required change, both the de-carbonisation of fuel in the supply-side and the demand-side management will have to be considered as the imperatives for the strategy formulation.

Figure 2. 5: Carbon dioxide concentration and temperature: evidence from ice cores



(Source: RCEP, 2000)

Figure 2. 6: IPCC CO2 stabilisation modelling



(Source: IPCC, 2001)

The degree of magnitude as to how much these strategic options should be promoted is a matter of argument. In Chapter 4, the definition of targets for the scenario modelling exercise will be elaborated in relation with the above context. Also, the strength of the required sustainability, together with its implications to the current challenges that Japan faces will be discussed.

2.6 Concluding Remarks

To sum up, the energy supply demand structure of Japan has to be understood within the context of the US-Japan relationship, which determined the level and the pattern of Japanese economic development. The current energy industrial structure, especially the electricity company formation, was a brainchild of the US strategy: the privatised electricity companies originally functioned to reduce the Japanese central government power over the energy industry, as well as to open doors to the Japanese market for the international oil companies. In exchange, the US supplied Japan with the technical assistance and the market for the final products.

The oil crisis in 1973 marked the turning point for Japan, making it realise the issue of national energy security. The energy source diversification policy was adopted, notwithstanding a various energy efficiency measures. Japan's oil imports have decreased from the peak period, while coal and natural gas imports are on the increase. Within the diversification context, nuclear energy also gained a position to replace the imported oil. Despite that the energy security policy was much discussed in reference to the national energy independence, the US-Japan co-operation continued for the nuclear development. Many argue that the nuclear deployment is only to exasperate the Japan's reliance on the US companies, as they control nuclear fuels transaction (Kihara, 1980, Okada, 1991).

Japan's currently proven fossil fuel reserves are regarded as immaterial, and the development of the indigenous energy sources is limited. However, the possibility of their future development should not be denied. For example, 821 million tonnes of coal is available for mining in Japan, while some natural gas reserves are also obtainable. With technical development, those reserves might be utilised. Technologies to develop renewable energies are comparatively well advanced in Japan. However, their practical application is again unsatisfactory, with a rather modest target for their further utilisation.

Energy demand in the industrial sector has been stabilised, while the demand of transport and residential/commercial sectors are on the increase. Japanese energy efficiency is higher in terms of international comparison, but there is room for further improvement. The electrification rate is growing. About 40% of the total primary energy supply is used to generate electricity. The other energy carrier systems are not sufficiently developed. Town Gas transmission systems are only available in the urban areas and the availability of district heating systems is minimal. On the other hand, smaller scale heat utilisation systems have been widely adopted in Japan. For example, 600,000 sq. m. equivalent solar heating systems for individual houses were produced in 1996 in Japan. This is as the same production level with the US (600,000 sq. m.), or more than the German level (150,000 sq. m.) (ANRE, 1999). Heat utilisation system for office building is also getting widely applied, especially after 1980s.

The energy industries were enjoying the virtual monopoly over each supply areas for decades, with the competition among and within the supply area being restricted. Market liberalisation, however, was brought into the policy contexts, as a means to bring economic efficiency. So far, the market liberalisation has been proved to be effective, mainly by putting unused energy capacity of the large scale manufacturing sites into power production.

The government-industry relationship, whose foundation dates back to the post W.W.II US policy, has been kept under tight control until recently. The idea of decentralisation is gaining a wider support in Japan, and it has a serious implication for the energy market. For example, there are a number of local initiatives which intend to enter into the electricity market with their renewable power generation capacities. If these local initiatives win a wider public support, with the necessary central government's financial backups, Japan's renewable energy development is expected to grow significantly (IEE, 1998).

Energy prices in Japan are generally higher than in other countries. Subsidies, which are ultimately levied to the energy end-users, are used to reduce the burden of energy industries. The situation is most represented by the EPRDSA, which gives significant financial support to the electricity companies to carry on nuclear development.

As the Japanese energy market is going through a series of deregulation and liberalisation policies, the existing relationships between the government and the electricity companies have been weakened, to the extent that the monetary incentives to continue nuclear development are not perceived attractive to the electricity companies. Some companies are turning to renewable energy

development. For example, Sony and Tokyo Electricity Company launched a joint programme to develop wind energy through the Japan Natural Energy Company (JNEC), which was established in April 2000 to intermediate green electricity certificate¹⁶ (Yomiuri, 2000). Expert debate whether this kind of relatively new initiatives will be materialised is dependent on the future government policy.

¹⁶ The scheme attracted several large-scale customers who see the green certificate purchase as part of their corporate environmental commitment (for further information, refer the JNEC homepage at <http://www.jnec.co.jp>).

Chapter 3: EXISTING "SCENARIOS"

3.1 Several Existing "Scenarios"

This chapter presents several "*scenario*" studies carried out in Japan. Its purpose is to demonstrate a wide range of study types and to highlight the background of the research. A large number of Japanese energy studies have been carried out with claiming their deployment of "*scenario*" analysis. Close examination soon reveals that most of these studies are based on simulation, in which the term "*scenario*" represents simulation "assumptions": Some of the studies, for example, concentrate on predicting outcomes of the "assumptions", instead of setting a trend-breaking target and analyse the implications of the target to the energy context.

As discussed in Chapter 1, however, Lovins called scenario "a description of how future events unfold, described chronologically and at least qualitatively in sufficiently vivid detail that readers can readily imagine themselves participating in the events it describes" (Lovins, 1977). This research takes the essence of Lovins' concept of "scenario" and defines scenarios as "strategic synopsis which describes chronological development of future actions". To make the clear

distinction, “scenarios” signify those in line with this definition, whereas “*scenarios*” as Italianised represent those which may deviate from it.

As the official government energy study has already been explained in the previous chapter, this chapter focuses on the other main studies carried out in Japan by the following organisations.

- 1) the Ministry of the Environment Japan (MoE)
- 2) the Citizen's Alliance for Saving the Atmosphere and the Earth (CASA),
- 3) the World Wildlife Fund (WWF),
- 4) the Japan Initiative (TJI)
- 5) the Research Institute of Innovative Technology for the Earth (RITE)
- 6) the Citizen's Nuclear Information Center (CNIC)

The description is provided for each study, which will be followed by critical review from the following perspectives:

- A) the types of the study, e.g. use of quantitative or qualitative analysis
- B) the nature of the study, e.g. whether emphasis is given to trend-following or trend- breaking

- C) the definition of "*scenario*", e.g. whether it purely represents simulation assumption or more about strategic synopsis

3.2 Study Analysis

3.2.1 The Ministry of Environment Study

3.2.1.1 Introduction

The Ministry of Environment (MoE) commissioned several energy experts to create multiple "*scenarios*" (Ministry of the Environment, 2001). The overall purpose of the study is to assess the implication of future Japanese social and economic development orientations, broadly based on the assumptions identified in the Special Report on Emission Scenarios (SRES), proposed by IPCC (Nakicenovic, et. al., 2000). Each "*scenario*" is to be correlated to the emission volume and is supposed to form the basis for assessment of the effectiveness of potential actions.

3.2.1.2 Study Procedures

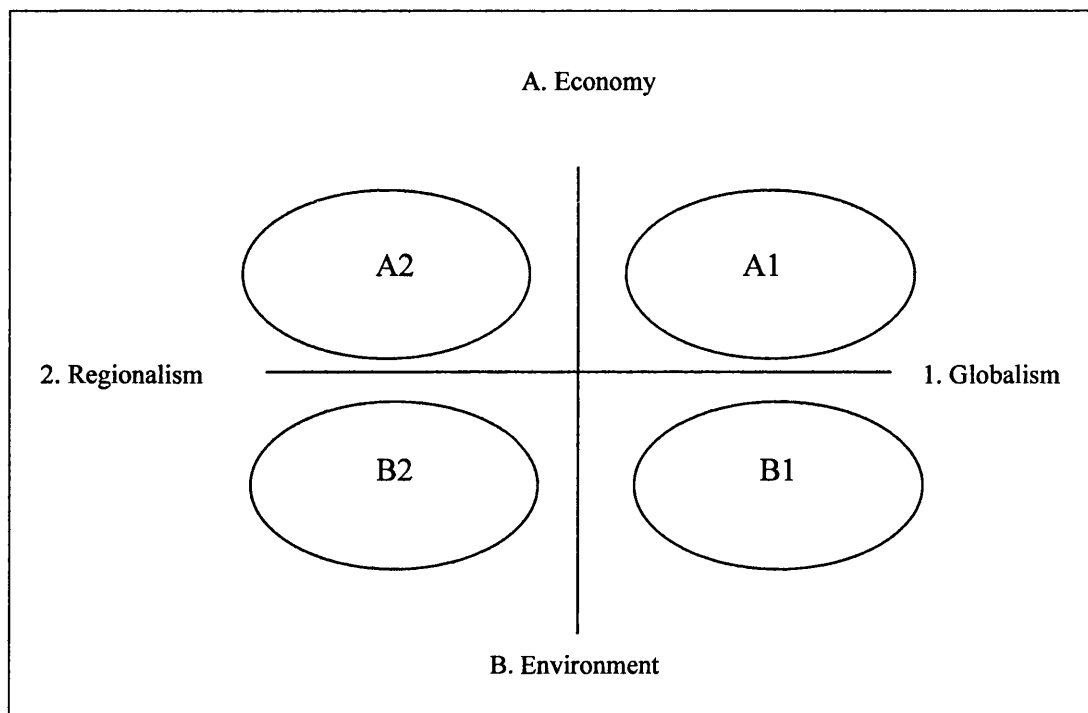
The MoE study procedure takes the following steps.

1. To create descriptive "*scenarios*" for Japan, based on the Special Report on Emission Scenarios (SRES), proposed by IPCC
2. To quantify individual parameters, such as future populations, industrial structure, gross domestic production and activity levels, are derived through several indicators
3. To predict the level of energy consumption and volume of CO₂ emission

3.2.1.3 Outlines of descriptive "*scenarios*"

As in the SRES, four "*scenarios*" (A1, A2, B1, B2) were established. All of the "*scenarios*" assume economic growth to some extent, but the overall orientations that the society pursues are different. For example, as shown in the figure 3.1, the axis A and B represents the strategic choice between economy and environment, whilst the axis 1 and 2 determines the level of globalisation or regionalism.

Figure 3. 1: Typology of Emphasis



(Source: Ministry of the Environment, 2001)

I. A1 *Scenario*: Global Market

Under the A1 "*scenario*", Japan faces increasingly globalising economy, and the social emphasis is given to the survival in the international competition. Economic rationality becomes to dominate the core of social value. As a result, high economic growth is achieved and employment opportunity enlarged for the people with superior performances.

With strong purchasing power, consumption level is also high. Pursuing of efficiency (though in rather narrow sense) penetrates to the people's value structure, to the extent that most of the household works be carried out outside of the family. The disposable time gained through this is set-aside for leisure and educational activities.

Under the A1, efficiency matters most. The population and the capital are centred around in a few mega-cities, as it is efficient to concentrate resources in selected districts. Railways and cars are the main transport means in the metropolitan area, whereas cars are dominant form of transport in suburban areas. Energy prices fall, as a result of energy market de-regulation. The increased competition leads to the expansion of fossil fuel uses, because they are cheap enough to appeal price-sensitive energy consumers.

II. A2 *Scenario*: Regional Conservative

Under A2 "*scenario*", the society prefers to conserve the existing social and economic frameworks. The fierce competition, such as that presumed in the A1 "*scenario*", is absent in the A2. Overall, the level of economic growth is lower than the A1.

The level of public spending is as high as that in 1990s. Also, the traditional Japanese employment practice, notably the life-long corporate job security, is maintained. People with higher performance are not necessarily given the status equivalent to their performance. As a result, the productivity does not increase, which makes the working hours per employee as the longest among other "*scenarios*".

The level of consumption maintained. Population distributed not only to a few mega-cities, but also to several regional cities. Public spending continued to be distributed among regions. Road transport networks are provided to connect local cities, meaning that the current level of public spending programmes continue. Nuclear remains to be the dominant source of energy.

III. B1 *Scenario*: Environmental Technology

The B1 "*scenario*" is highly technology oriented. It aims to achieve economic growth as well as reduction of material dependency. Environment dominates social values, insofar as investments concentrate on environmentally sensible causes. Raw materials are reproduced through waste material recycling.

Environmental awareness enlarges business opportunities: as a consequence, some level of economic growth is achieved.

Under B1, social welfare, as well as environment, secures a high priority. Childcare business supports women entering the job market. Social welfare is also pursued through technological development. For example, insulating housings can improve high heat efficiency. In this way, quality of life, particularly for old people, is enhanced whereas energy consumption is reduced.

Land-use planning functions to restrict the size and location of cities. Metropolitan transport is mainly provided by public transport (e.g. light rail transport). Most of the car use fuel cells engine. Natural gas and fuel cells become the main forms of energy supply.

IV. B2 *Scenario*: Regional Independence

Under the B2 "*scenario*", individual regions hold production-consumption integrity. Size of cities is rather small and it contributes to their self-sufficiency. The decision-making is done at community level, in which non-government environmental organisations play active role to provide information and support

for the local decision-making. Within the self-sufficient regional unit, industry interconnections are arranged in a way to minimise waste. As well as the B1 "*scenario*", the B2 aims to sustain economy and the environment at the same time, but it tries to do so through changing of people's values, rather than through technology. As the people's requirement for material *consumption* is replaced with material *utility*, the demand for new products are reduced: People may regard expensive but durable products more appealing, as they can use them for longer period by repairing them many times. Industrial structure shifts from manufacturing to the more service oriented businesses.

The small size of communities enables more environmentally benign transport means (e.g. bicycle). Public transport is more preferred by people to private vehicle transport. Employment opportunities are shared between higher and lower performance workforces. Working hours reduced as a result of the "work sharing" between them.

The energy demand in this "*scenario*" is the lowest. People's awareness towards environmental issues is high. Local community's decision making is respected, which prefers low-risk energy option than the high risk ones. Energy fuels, which are locally viable (e.g. biomass), become the main sources for energy supply. The

decrease of energy demand keeps large-scale energy generation development minimum. As a result, no new nuclear development is pursued.

3.2.1.4 Study Result

Based on the "*scenarios*", CO₂ emissions up to 2030 are estimated. Take the 1990 level as 100, A1 result is 144, A2: 114, B1: 103, B2: 94. Other main findings of the study are as follows:

- CO₂ emission volume will be the largest under the A1 "*scenario*", reflecting its underlying emphasis on cheap energy supply through fossil fuels.
- Under the A2, energy demand is high in relation to GDP growth. The nuclear deployment, however, helps CO₂ emission reduction.
- Economic growth and energy requirement is de-coupled under the B1. As a result, energy requirement relative to GDP is the minimum among other "*scenarios*".
- For the B2, since technological development is relatively modest, CO₂ emission volume per GDP is nearly the same level as the B1, though the size of economy is smaller than that of the B1.

3.2.1.5 Critical Review of the Study

1) The types of study: Qualitative vs. Quantitative?

The MoE study can be seen as the combination of qualitative and quantitative analysis. The study emphasis is placed on how the strategic elements influence the society's overall energy requirement and emission volumes. Thus the parameters used are not just technological options, but include social choices. The study is meaningful in terms of reminding the importance of the strategic elements in consideration of energy analysis, especially in the Japanese research context where technical discussion often dominates the climate change action debates.

2) The nature of the study: Trend following or trend breaking?

It is difficult to determine the study is essentially trend following or trend-breaking. There are many social strategic choices identified by the study. It does not, however, answer how to materialise the strategic measures. In other words, the study does not identify the detailed policy options that should be taken to substantiate each vision. Also, although the study tries to identify story lines leading to the 2030 future images, it does not recognise different time-scale (e.g.

the short-medium-long term) priorities.

3) The Definition of *Scenario*

It is also not very clear the definition of "*scenario*" in the study: the "*scenario*" identified by the study seems to represent the vision itself, rather than any policy path to achieve a certain vision. In this way, the study does not provide the "path" towards a particular vision. Overall, the "*scenario*" in the study stands for the outline of a fixed future rather than chronological identification of the necessary actions to reach it.

3.2.2 CASA Study

3.2.2.1 Introduction

CASA is a non-governmental network established in 1988. It has conducted several researches and made policy proposals on a various environmental issues. With its strong support from academic researchers, lawyers and concerned citizens, it is working extensively on the climate change issues. It is also known as one of the pioneering Japanese networks successfully affiliate with international

initiatives, such as the Climate Action Network (CAN)¹.

CASA has engaged in "*scenario*" studies for climate change action since 1997.

Based on its detailed analysis produced in 1997, CASA carried out a revised study in 1999 (Mizutani, et. al., 2000).

In the 1999 study, CASA proposed a number of technical options potentially available by 2010 to reduce CO₂ emission. CASA also tested the CO₂ reduction potentials of their proposed options through a simulation on numerical modelling, called the "Target 2010 Model". The model was composed of 6 individual sections dedicated to calculate energy requirement and CO₂ emission volume of sectors (industrial, transport, household, electricity production and waste management).

3.2.2.2 Study Procedures

The study involves the following steps:

¹ The Climate Action Network (CAN) is a global network of over 287 Non- Governmental Organisations (NGOs) with an aim to promote actions to limit human-induced climate change to ecologically sustainable levels. Further information is available at: <http://www.climatenetwork.org>

1. Service demand is first assumed through a various factors such as GDP, number of households, and the size of commercial activities.
2. Technological options are chosen to satisfy the service demand identified at the stage 1. Different assumptions were established on the level of energy efficiency for the technical options.
3. The energy demand is then calculated on the above assumptions for each sector. On electricity sector, a special consideration is given to the degree of fuel switching.
4. Also, different assumptions were brought into the level of service demand and degree of technical options available for waste management.

According to the study, a large number of cases (1458) are conceivable for the combination of these assumptions. To make it simple, the simulation tests 4 selected cases (Table 3.1).

A) Business as usual:

It assumes the level of energy efficiency, energy demand, the energy development strategy and waste management strategy follow the status quo as those in 1997.

B) Government assumptions:

It assumes the level of energy efficiency, energy demand, the energy development

strategy and waste management follow the government assumptions.

C) Target 2010 technical action:

It assumes the level of energy demand follows the current trend, but the energy efficiency, energy development strategy and waste management strategy follow the CASA default assumptions.

D) Target 2010 technical action & structural change:

It assumes the level of energy demand decreases as CASA assumes. The energy efficiency, energy development strategy and waste management strategy also follow the CASA assumptions.

Table 3. 1: CASA Assumptions

	Business as usual (BAU)	Government assumption	CASA technical action	CASA comprehensive technical action
Service Demand				
BAU	○			
Government Technological Action		○		
CASA Assumption			○	○
Energy Efficiency				
BAU	○		○	
Government Strategy ²		○		
CASA Structural Change Assumption ³				○
CASA Transport Management Assumption ⁴				○
CASA Energy Efficiency Assumption ⁵				○
Energy Development				
BAU	○			
Government Strategy		○		
CASA Assumption			○	○
Waste Management ⁶				
BAU	○			
Government Strategy		○		
CASA Assumption			○	
CASA Assumption + Waste Reduction ⁷				○

(Source: Mizutani, et. al., 2000)

² Government Strategy represents the case where transport, household and commercial service demands decrease, as the government predicted.

³ The CASA Structural Change Assumption represents the case where manufacture production decreases, as a result of structural change and reduction of the public construction programmes.

⁴ The CASA Transport Management Assumption represents the case where transport service demand decreases as a result of a various demand management programmes.

⁵ The CASA Energy Efficiency Assumption represents the case where household and commercial service demand decreases.

⁶ The BAU, the Government Strategy and the CASA Assumption all assume the amount of waste incinerated increases until 2010, following the existing rate.

⁷ The CASA assumption for waste reduction represents the case where industrial waste reduced by 25% from the predicted level and domestic waste reduced by 20% from the predicted level.

3.2.2.3 Study Result

The result of the simulation for each sector is demonstrated in the table 3.2

Table 3. 2: Energy Demand and CO2 Emission Volumes

CO2 (10,000 ton-cabin)	1990	1997	BAU	Gvmt Strategy	CASA Assumption		CASA Assumption + Waste Reduction	
					Nuclear 40 years	Nuclear 30 years	Nuclear 40 years	Nuclear 30 years
Energy	2,111	2,277	2,550	2,206	2,084	2,260	2,031	2,185
Industry	13,372	13,454	14,172	12,542	11,520	12,148	10,498	11,051
Transport	5,793	7,028	8,114	6,772	6,697	6,736	5,732	5,767
Commercial	3,395	3,886	4,660	3,354	3,116	3,564	2,969	3,372
Household	3,766	4,238	5,253	3,854	3,564	4,030	3,340	3,736
Others	278	496	0	0	0	0	0	0
Sub total	28,715	31,380	34,748	28,728	26,980	28,738	24,570	26,111
Against 1990	-	9.3%	21.0%	0%	-6%	-1%	-14.4%	-9.1%
Industrial Process	1,604	1,623	1,837	1,804	1,632		1,362	
Waste Management	349	401	666	666	666		532	
Sub Total	1,953	2,24	2,503	2,470	2,298		1,894	
Against 1990	-	3.6%	28.2%	26.5%	17.7%		-3.0%	
Total	30,668	33,404	37,251	31,198	29,278	31,036	26,464	28,005
Against 1990	-	8.9%	21.5%	1.7%	-4.5%	1.2%	-13.7%	-8.7%

(Source: *ibid.*)

The main findings of the study include the following:

- 1) The deployment of wide range of energy efficiency technical options can bring

CO₂ emission reduction to the extent to meet the Kyoto target, even if no nuclear power stations are developed. Even if the nuclear phase out policy is adopted to gradually abolish them over 30 years, energy related CO₂ emission volume could be kept at the 1990 level, as long as some technical options are adopted.

- 2) Structural and lifestyle change, in combination with technical options, can further reduce the level of CO₂ emission.
- 3) If appropriate actions are taken, it is possible to achieve the Kyoto target only through the domestic measures.

3.2.2.4 Critical Review

- 1) The types of study: Qualitative vs. Quantitative?

The advantages of the CASA study are in its richness in data and thorough examination of technical and other options. Thus, the study is essentially a quantitative simulation. The simulation is, however, followed by a various policy recommendations, though their direct effects are not taken into account in the simulation itself.

On the other hand, the CASA has identified the study disadvantage as that it is not being able to assess the effect of cross-sectional options, such as carbon tax, as the simulation model is divided into sector categories. The model also does not simulate the secondary economic effect of the options in consideration. For example, the simulation does not reveal the extent to which R&D budget is needed for a company to take up a certain technical option.

2) The nature of the study: Trend following or trend breaking?

The study sets up ambitious assumptions and it tries to prove the assumptions are sufficient to achieve the CO₂ reduction target. The study should, therefore, be seen as a numerical attempt to validate trend breaking feasibility.

3) The Definition of Scenario

The term "*scenario*" represents simulation assumption, rather than chronological synopsis for strategic actions. The study concentrates technologies and policies which could be available in the period from 1999 to 2010, therefore, priority analysis on chronological schedule is not its main concern: every policy identified is important, and should be put into practice no matter which comes first.

Nevertheless, it would be more sensible if policies necessary for long term CO₂ reduction were included in the argument. To illustrate, construction of gas pipeline was not discussed in the study, as it may have been regarded infeasible during the specified period. This could be, however, one of the important policy options for longer perspective, and may better be identified as a potential measure to have a full effect later on.

Nevertheless, the significance of the CASA study should be emphasised. During the formulation procedure for the National Long-Term Energy Forecast, the CASA study was referred as an alternative to the discussed national policy. It has been regarded as one of the most important energy analysis ever carried out by a non-governmental environmental organisation in Japan.

3.2.3 World Wildlife Fund Japan (WWF Japan) Study

3.2.3.1 Introduction

WWF Japan has set up a special task force to assess the possibility of CO₂ emission reduction. Like CASA, it has conducted a preliminary study in 1997 to examine and simulate the feasibility of CO₂ reduction by 2010. The 2001 project

is based on the previous study in 1997, but it tries to expand the scope up to 2020.

3.2.3.2 Study Procedures

WWF has produced a report in 1997 to assess technical potentials to reduce Japan's CO₂ emissions (WWF Japan 1997). The 2001 report is to expand the 1997-study by enlarging the number of technical options (WWF Japan, 2001). The WWF simulation, based on the method called AIM model, is to test the CO₂ reduction possibility in a case where the following elements are pushed forward (Table 3.3).

- Technological advancement
- Development of service sector
- Lifestyle change
- Introduction of international flexible mechanism

The AIM model is based on the energy service requirements from different sectors.

The energy requirement is calculated in the following steps:

1. The overall requirement for energy is summed up

2. The most economically efficient technologies are automatically selected
3. The energy service requirement (as above 1.) and the energy technology (as above 2.) are combined to estimate overall energy requirement and CO2 emission volume

Table 3. 3: Assumptions for WWF study

	Directions/policies of <i>Scenario</i>	Contents
Advanced Technologies with High Efficiencies	Despite present progress in variety of technological innovations, it remains uncertain if we can achieve feasible functions and lower costs of fuel cells and LED lighting. However, in the case of photovoltaic, their cost declines along with the learning curve. This indicates that not only research and development, but wide promotion of penetration holds a major factor to reduce the costs. Thus, in this <i>scenario</i> , this mechanism shall be actively pursued.	Hybrid cars Fuel cell vehicles Highly efficient fluorescent lights LEDs (Light Emitting Diodes) Inverter-controlled motors Fuel cell co-generation Amorphous transformer Highly efficient industrial furnaces Photovoltaic Wind power Biomass
Service Economy	In place of businesses that handle production, sales, usage and disposal of goods, businesses that provide services, repairs and recycling through rentals or leases shall be encouraged. This policy is consistent with the direction for a sustainable waste/resources management-oriented society in which materials and resources are used for longer terms with better care. At the same time, such businesses will help to create new employment.	To encourage renovation businesses To encourage rent-a-car businesses or car-sharing businesses Automobile maintenance Repair and recycle of electrical home appliances Office rental services Service for highly efficient utilization of motors (ESCO) Distribution of highly efficient light bulbs
Reforming our lifestyle	To date, our society has allowed over consumption of energy and resources. From now on, it is necessary to work for a lower consumption lifestyle through tax reform and/or incentive measures.	Incentives to promote small light-bodied cars Eco-train commuter passes Eco-driving licenses Usage-control of excessive lighting, cooling, heating and air conditioning
CDM/JI	Reduction of greenhouse gases shall be done in the most cost-effective way through energy conservation or clean technology projects between developed and developing countries (CDM), as well as between developed countries (JI).	Construction of natural gas power plants Installation of photovoltaic, wind power, biomass and biogas power generation facilities Energy conservation technology transfer

(Source: WWF Japan, 2001)

3.2.3.3 Study Results

The simulation result is summarised in the Table 3.4. The WWF claims possibility of CO₂ emission volume reduction to 90% of the 1990 level by 2010.

Table 3. 4: CO₂ Emission Volume by WWF (ratio to the 1990 level)

Sector	1990	1998	2010	2020
Industry	514	499 (97)	451 (88)	391 (76)
Household	139	152 (109)	124 (89)	100 (72)
Business	123	143 (116)	114 (93)	104 (85)
Transportation	217	265 (122)	205 (94)	162 (74)
Energy Transformation	57	61 (107)	54 (94)	44 (76)
Total	1,051	1,120 (107)	948 (90)	802 (76)

Unit: million tons CO₂

(Source: *ibid.*)

In general, the research emphasis is strongly on technical possibility. It is primarily concerned with listing technological options that could be effective in CO₂ reduction, but not so much on the means which could make the technological option available.

Nevertheless, the study made recommendations for future energy policy, which are summarised as follows:

1. Vehicle tax reform should be carried out to make the tax rate proportional to the vehicle fuel efficiency
2. Revise subsidy policy for energy efficiency and renewable energy. Encourage their market penetration, rather than only obsessed with research and development of the particular technologies (especially on Hybrid car, fuel cells and LED lighting)
3. Encourage new environmental businesses, such as ESCO, electronic equipment repairing services and vehicle maintenance and rent-a-car businesses
4. Introduce "carrot" for life style change, e.g. public transport flexibility pass
5. Introduce a regulatory mechanism to ensure electronics stand-by charge minimum: There are already technologies in Japan to make the stand-by charge below 0.1 watt or less. Regulatory tools should be in place to make those technology widely available

3.2.3.4 Critical Review

1) The types of study: Qualitative vs. Quantitative?

The WWF study is predominantly of a quantitative simulation based on different

assumptions about the degree of technical options. The advantage of the study is that, by giving the service requirement exogenously, the model is used to calculate the extent to which solely technological options can reduce CO₂ emission volume. It figures out what sort of technologies should be deployed, while maintaining the production level or overall standard of life as they are.

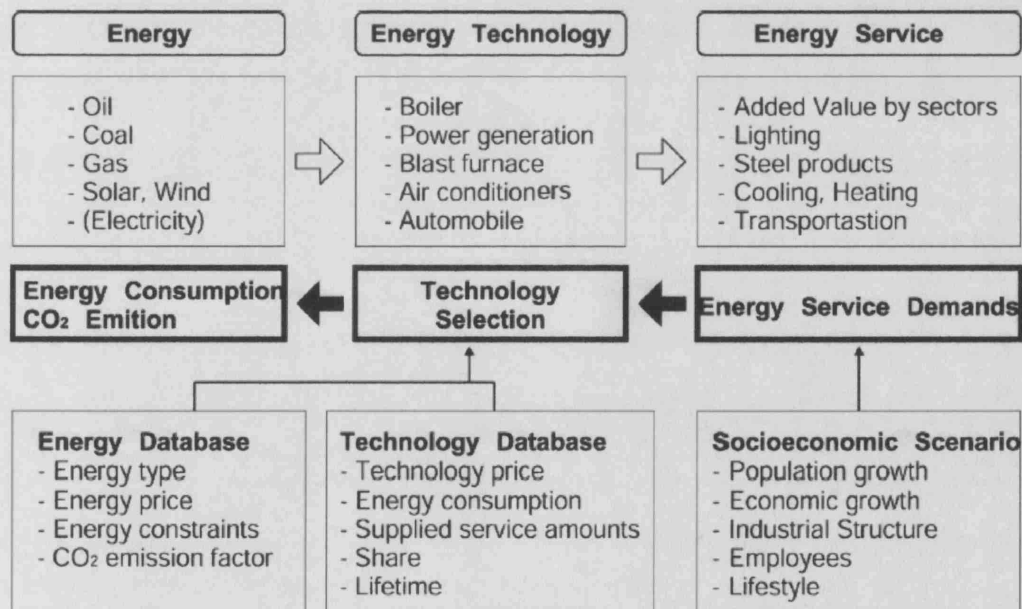
2) The nature of the study: Trend following or trend breaking?

Like the CASA study, the WWF study sets up ambitious assumptions and it seeks to demonstrate the sufficiency of the options to achieve the target. In the WWF study, however, the overall emphasis was given to even more technical options than in the CASA study. For example, a majority of the CO₂ reduction effects are assumed to derive through development of hybrid car and fuel cells car, whereas modal shifts are supposed to play a limited role. Also, for some technical options, their indirect effects is not clearly defined. For instance, the study assumed the replacement of household electric equipment (e.g. refrigerator) with better efficient new products. The study, however, does not identify how much the product replacement pushes up material consumption, and how that results in emission increase.

3) The Definition of *Scenario*

The figure 3.2 demonstrates the structure of the AIM model, used as a basis for the WWF study. It is clear from this that "socioeconomic scenario" in this study represent simulation assumptions on population growth, economic growth, industrial structure, employment and lifestyle, rather than chronological description of strategy.

Figure 3. 2: The structure of the AIM model



(Source: *ibid.*)

In the WWF study, the potential of many technological options for contributing to the CO₂ reduction were calculated. Neither the timing nor the priority of those options is unclear, and the listed options were treated as if they are put into practice at the same time. There is no clear discussion as to what policy can make each technological option available.

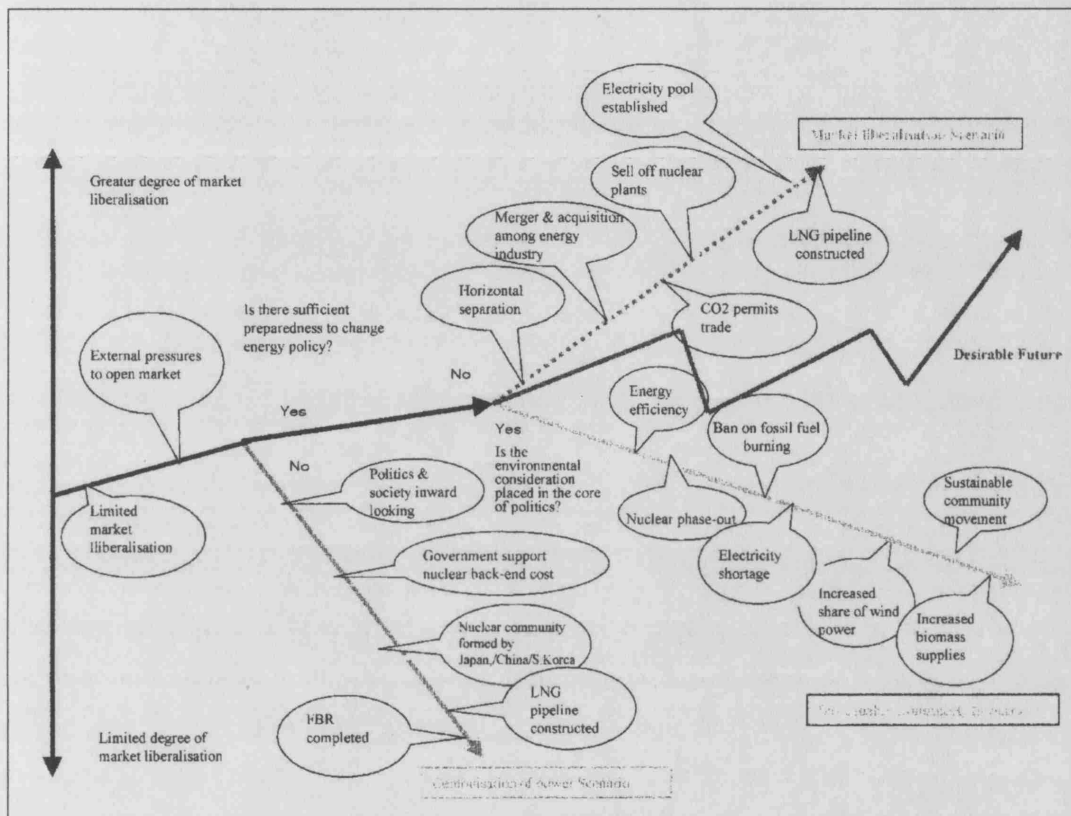
3.2.4 The Japan Initiative Study

3.2.4.1 Introduction

The Japan Initiative (TJI) is an independent research institute set up to advocate on a various social issues. One of their research topics is the energy and the environment. TJI carried out a "*scenario*" analysis up to 2030 (Japan Initiative, 2001).

The Japan Initiative's study is mostly qualitative. It developed several "*scenario* logic". The "*scenario*" logic consists of packages of assumptions that describe possible development along the main story line. It co-ordinated assumptions in a different packages to demonstrate a various paths leading to future images (Figure 3.3).

Figure 3. 3: Japan Initiative's Scenario Logic Tree



(Source: Japan Initiative, 2001)

There is no definite time-scale identified for the *scenario* development. The main emphasis is on the choice among different story lines. Some specific questions (e.g. whether the energy policy is ready to be changed, or whether environmental considerations become critical issues at the political level) are placed at the point of determining choices among different story lines.

3.2.4.2 Principal Features of the "*scenarios*"

Main assumptions for each story line are as follows:

I. *Scenario* 1: Case of state dominance

Scenario Description:

With the increasingly strong pressures from the international communities, the domestic energy industries fiercely lobby the government to take protectionism steps. The energy liberalisation programmes fail, while the existing government-industry coalition is as tight as ever. The lack of sophistication in foreign diplomacy only allows the passive role of the Japanese government and industry in the international environmental negotiations.

The "traditional" liaison between the government and politician with vested interest dominates the energy policy decisions, making it impossible to bring any drastic strategic change. The public is rather isolated from the decision-making: Under the name of "national interest", defined by the government, the market monopoly continues, with nuclear share increases steadily.

Japan actively markets its nuclear technologies to the neighbouring countries, through which it gains international carbon credits. The market monopoly enables the continuation of the current energy pricing practice though it has been often criticised by its opaqueness. Thus, although carbon tax is introduced, the burden of the tax is simply passed on to the energy consumers. The nuclear development cost is also passed onto the end-users.

The main features of the "*scenario*" can be summarised as follows:

- Continuation and expansion of nuclear subsidy, including the development of FBR
- Development of the North Asian Nuclear Reprocessing Agreement which covers China, South Korea, Japan
- Abandonment of energy market liberalisation
- The traditional big energy players dominate, with massive support from the government
- Maintain vertical integration, the existing price mechanism and regional monopoly
- Nuclear positioned as a key technology for CO₂ reduction: Aggressive

promotion of nuclear technologies to the developing countries, through which Japan obtains CO2 permits

II. *Scenario 2: Market Liberalisation*

Against the background of further international pressures, this "*scenario*" follows the path to the full energy market liberalisation. The involvement of foreign capitals may lead to energy market re-organisation through corporate mergers and acquisitions, which Japan has not experienced for decades.

Scenario Description:

Full liberalisation is completed, involving both foreign and domestic energy industries. As the liberalisation progresses, the electricity and gas companies drastically shift their business emphasis from public service to profit making. Environmental consideration is marginalised, because the capitalistic principle is the only element which decides the winners and losers in the market.

As the role of the government is restricted only to maintain fair competition, the market players have to survive on their own. As part of their survival strategies,

expensive technologies, notably nuclear, lose its justification, and its share in the energy supply structure sharply declines. Financial technology developed by the West is gradually adopted in Japan in the context of risk diversion against energy price fluctuation.

The market principle is the ultimate value in this "*scenario*", to the extent that new environmental mechanisms, such as CO₂ permit trade and green tax reform, are only partly substantiated, so as not to infringe the market efficiency. The carbon tax is regarded as an unnecessary burden which undermines the national competitiveness. Environmental awareness in the society is rather low, and the environmental externality is out of public concern.

The main features of this "*scenario*" can be marked as follows:

- The horizontal separation is completed and a new electricity pool market is created to form the basis for full competition. In this circumstance, nuclear is no longer the "seeded" energy source. It has to stand on the level playing field with the other types of energy fuels.
- Energy security is sought through a new financial mechanism, rather than through petroleum storage.

III. *Scenario 3: Environmental Emphasis*

The CO₂ reduction issue is firmly rooted to the international framework where UNFCCC agreements bring tighter reduction targets, e.g. CO₂ has to be reduced by 30% compared to the 1990 level.

Scenario Description:

Market mechanism functions on the basis of some principal social agreement. The internalisation of the environmental externalities is one of these agreed items. New entrants to the market are strongly supported by the government at an initial stage of their entrance, but the government support later phased out to let the players freely compete in the market. The principal roles of the government are not only limited to ensure of "fair play", but also the achievement of the socially agreed objectives, including environmental sustainability. This goal is shared among the government and private sectors, and their co-operative relationship is established.

Positively pressurised by the active citizens and environmental groups, the

government plays a central role to reduce atmospheric emissions. For example, the CO₂ emission permit trade and "greening" of the existing tax systems are materialised. The socially valuable infrastructure, such as district co-generation systems and LNG pipeline, is financially supported by the central government. The central government's involvement also extended to methane hydrate recovery technology, fuel cells, and micro gas turbine development. These technologies became commercially available by 2015-30. The energy companies are no longer able to remain secretive about their financial decisions. On the other hand, regulatory signals and the environmentally aware customers made the energy companies to find new business opportunity, e.g. in the fields of energy efficiency consultancy and renewable energy marketing.

The characteristic event to this "scenario" includes the followings:

- Renewables gain the position as the post fossil and post nuclear energy source.
- Feed-in tariff is introduced to encourage renewable energy production
- A new legislation is adopted to ban fossil fuel use.
- Electricity production is reduced through environmental legislation
- Electricity storage becomes common technology

- Economy may suffer from energy price increase

3.2.4.3 Critical Review

1) The types of study: Qualitative vs. Quantitative?

The Japan Initiative's study is the most descriptive and qualitative analysis among all other "*scenario*" analysis reviewed.

2) The nature of the study: Trend following or trend breaking?

A "desirable *scenario*" (*Scenario 3*) is provided. The actions associated with the desirable *scenario* can be seen as the necessary steps to be taken to achieve the identified future. Thus, by setting up a desirable future and identifying the path to it, the TJI study has a trend-breaking element.

3) The Definition of *Scenario*

The term "*scenario*" is most appropriately used to portray chronological strategic order. In the study, "*scenario*" is not simply the future assumptions, but it

represents detailed paths towards a set of future vision.

The different options were associated with the different "*scenarios*", which makes easy to recognise the characteristics of the each "*scenario*". On the other hand, this gave the impression that the options are mutually exclusive. For example, some options (such as fuel cells development) may be pursued by the big multinational companies at any rate, and they may be available regardless of which "*scenario*" is follow. Yet, the clear one-to-one correspondence between the identified options and "*scenario*" in this study may preclude the issue of mutual applicability.

Also, it does not answer to the question of how the change of direction can be achieved at the crucial turning points. For example, in the "*scenario*" logic, the two critical questions were asked on: 1) whether government and industry alliance is resolved: 2) whether environmental awareness among the general public could be raised. The study does not provide answers what would be the deciding power on these questions. In other words, environmental awareness may be raised by enhanced information to the public, but such strategic actions that change of *scenario* courses are not specified.

Nevertheless, this study has a remarkable character and merit, in marked contrast to some studies which are valuable but predominantly a technology assessment.

3.2.5 RITE Study

3.2.5.1 Introduction

The Research Institute of Innovative Technology for the Earth (RITE) is a government funded research arm whose mission is to develop and disseminate technologies.

In 2000, under the editorial supervision of Mr. Yoichi Kaya, the leading figure for the Japanese energy policy making, the RITE produced a study called "CO₂ Reduction Strategy: the *Scenario* to Save the Earth" (Kaya, 2000).

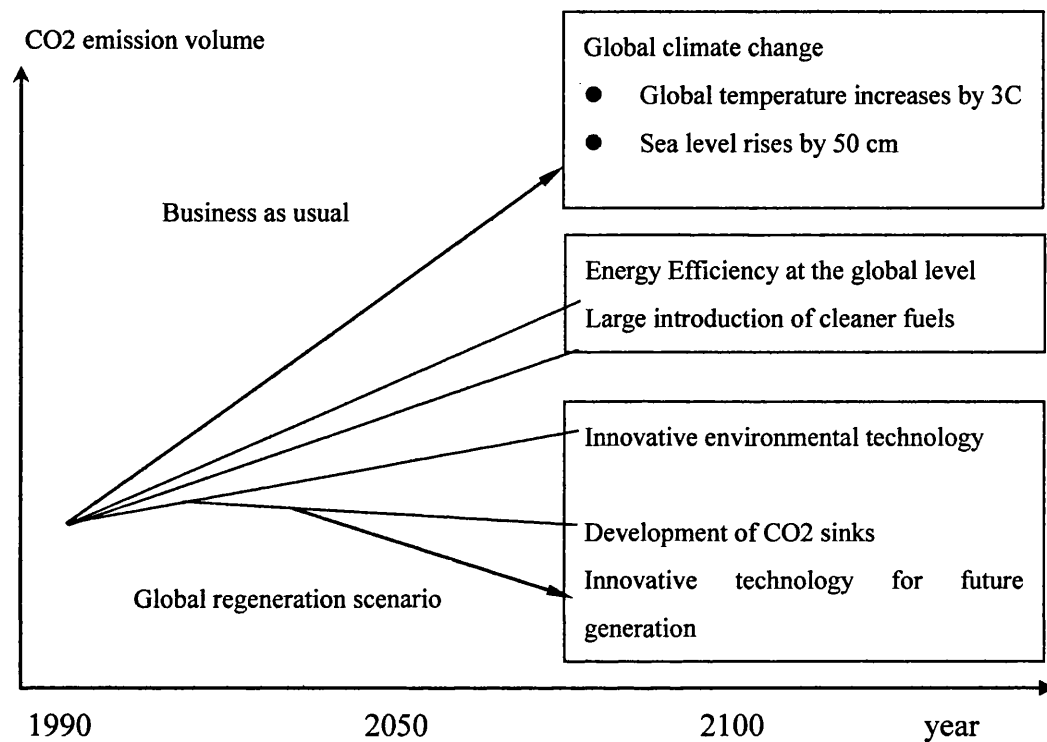
The RITE study's aim is to propose the best energy composition for several regions in the world. It established a long-term target to reduce CO₂ to 550 ppm.

3.2.5.2 Study Procedures

The study identifies the main characteristics of the future energy options as follows:

1. Energy efficiency adopted at the world-wide level:
2. Large introduction of "clean energies" which include fuel switch from coal to gas, development of renewables and nuclear power:
3. Innovative "environmental" technologies including CO₂ sequestration, deposition and recycling:
4. Develop "sink" functions through extensive forestation:
5. Development of new generation technologies such as outer space solar power generation, nuclear fusion

Figure 3. 4: Global re-generation "*Scenario*" by RITE



(Source: Kaya 2000)

The RITE explains that these technological principles are along the line with the Japanese government proposal for "global-regeneration" programme.

The study adopted a simulation based on the "Dynamic New Earth 21 (DNE 21)" model⁸. It is claimed as the model divides the world into 10 different regions, then

⁸ For the details of the model, refer Fujii, Y. and Yamaji, K., (1998), "Assessment of technological

figures out the best energy compositions for each region to reduce CO₂ at the minimum cost.

The simulation first produces the overall global target that has to be achieved worldwide. The details of the world targets are as follows:

- Primary energy production has to be reduced to 70% of the BAU case
- The most affected energy fuel to achieve the target is coal and oil. It is necessary to develop non-fossil energy sources such as nuclear, biomass, solar power and hydropower after 2050. The share of natural gas, whose GHG potential is relatively lower than the other fossil fuels, should also be increased.
- After 2040, the biomass will see the drastic increase in the primary energy structure. The figure 3.4 demonstrates the Japanese energy consumption trend identified by the study.
- The simulation result demonstrates that, the world will not reduce CO₂ emission volume, compared to the BAU case until 2040. The prices of hydrogen and methanol are relatively expensive, thus the possibility of wide

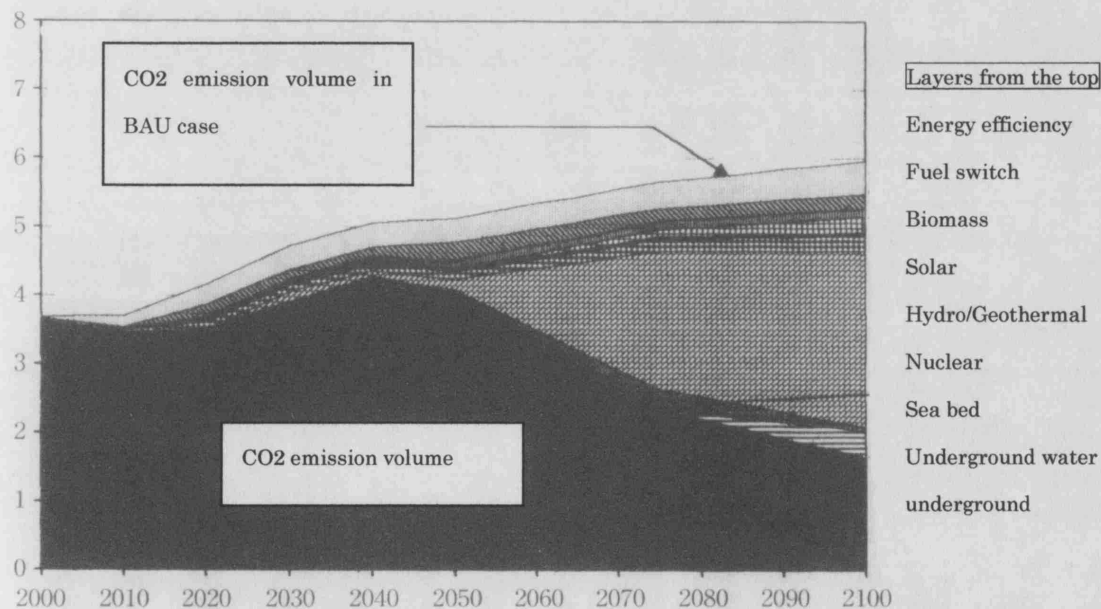
options in the global energy systems for limiting the atmospheric CO₂ concentration”, Environmental Economics and Policy Studies, 1, pp113-139

adoption of these fuels are limited during 2000 to 2040. After 2040, a share of fossil fuels is dramatically reduced, as they are replaced by methanol, hydrogen and biomass.

3.2.5.3 Scenario for Japan

In order to achieve the above global "*scenario*", the study identified that Japan should reduce its CO₂ emission volume to 370 million tonnes (93% of BAU) by 2010, 410 million tonnes (79%) by 2050 and 170 tonnes (28%) by 2100.

Figure 3. 5: CO₂ Reduction through RITE Structure



(Source: *ibid.*)

The study result shows that it is economically efficient to purchase CO2 emission permits through international trading mechanisms for the periods of 2010 to 2050. As the CO2 emission ceiling becomes tighter, especially after 2050, it is necessary to reduce CO2 more by extensive reliance on nuclear technology and CO2 sequestration (Box 3.1).

Box 3. 1: Principal Features of the Simulation Result

The principal features of the simulation result are:

Up to 2050, CO2 reduction to be materialised through

- Fuel switch from coal to LNG
- Energy efficiency
- Deployment of more hydropower & geothermal technologies
- CO2 permit trade

After 2050,

- Large introduction of nuclear power (contribute 60% of the total CO2 reduction)
- CO2 sequestration

The study carried out further simulation to identify the effect on other key assumptions.

1) Assumptions 1: Without massive nuclear development

If ever the nuclear phase-out has to be carried out, Japan will lose its means to reduce CO₂ emission during the period after 2050. The study suggested massive CO₂ sequestration into marine or deep-underground depository is required if nuclear option is absent. Energy efficiency is not considered as an alternative to reduce CO₂ emission, as the study stands on the assumption that high degree of energy efficiency was already achieved by 2050 to the extent that there is no room for further efficiency improvement.

2) Assumptions 2: Without CO₂ sequestration

If CO₂ sequestration is not considered as an option, further energy efficiency and nuclear development are necessary

3) Assumption 3: Fuel Switch

If neither nuclear nor CO₂ sequestration are adopted, further energy efficiency, further fuel switch from coal to LNG, and "clean but expensive energy sources", such as renewables, have to be introduced. The study claims that Japan is not

endowed with sufficient wind or solar potentials compared with other countries, thus CO₂ reductions through these technologies are limited. It concludes it is more "economically sensible" to reduce CO₂ emission outside of Japan.

3.2.5.4 Critical Review

1) The types of study: Qualitative vs. Quantitative?

The RITE study is heavily simulation oriented. It is based on a model called DNE 21. The study, however, is based on information to favour nuclear and CO₂ sequestration in a distorted manner. For example, it assumes the cost of nuclear as US\$2000/kW, with annual operation cost of 19%, but this cost of nuclear does not cover the externalities. Also it does not count the subsidies funded to it. On the other hand, renewable costs do not count the possible decrease of facility prices resulting from mass production. Thus, although the simulation deploys extensive and sophisticated numerical calculations, the principal assumptions for the simulation need careful readjustment to reflect the reality.

2) The nature of the study: Trend following or trend breaking?

It is difficult to categorise the study as trend breaking. The study claims that it tries to propose strategies to bring massive CO₂ emission reduction. As it promises, it proposes a combination of main energy options. The problems is that the study assumption is distorted to the extent that the simulation result looks like nothing else than propaganda for nuclear and CO₂ sequestration. From the results, it is highly difficult to obtain meaningful insight as to sensible strategies.

3) The Definition of *Scenario*

In the study, the term "*scenario*" is taken to mean the combination of fuel structure which targets CO₂ level below 550 ppm by 2100. Chronological consideration (in terms of the energy fuel structure over the period from 2000 to 2100) is somehow available. It is, however, highly difficult to neither draw any substantial strategy out of the regeneration "*scenario*". The study claims the global "*scenario*" and individual "*scenarios*" are to "save the earth", but as the study's obsession with the nuclear certainly leave the impression that their proposed "*scenario*" may never be sustainable. It is not clear how much serious consideration was given to the negative cost of nuclear development.

3.2.6 CNIC Study

3.2.6.1 Introduction

The Citizen's Nuclear Information Center (CNIC) was established in 1975 with the vision to provide fair and transparent information about the energy and nuclear issues.

In 2001, CNIC has produced a simulation study with the period up to 2010 (Katsuta, 2001). The purpose of the study is to assess the effectiveness of CO₂ reduction options. The main emphasis of the study is to evaluate the feasibility of nuclear phase-out and potentials of energy efficiency and renewable energies.

3.2.6.2 Study Procedures

The main features of the CNIC study procedures are as follows:

1. Determine the total service demand, based on the gross domestic production, future population, transport demand and the level of industrial production, etc.

The study deliberately follows the service demand forecast of the government to make the study directly comparable with the government assumption.

2. Exogenously establish the extent to which energy technologies will be adopted
3. Identify the primary energy requirement which satisfies the final energy demand

As for the electricity production, the study prepared a several different assumptions to test the different combination of fuel mixture.

The principal socio-economic indicators and energy service demand are shown in the table 3.5. The energy technologies to satisfy the above demand are assumed as table 3.6.

Table 3. 5: Socio-Economic Indicators and Energy Service Demand

		1990	1998	2010	Unit
Economic Indices	GDP	430	-	593	100 Million Yen
	Economic Growth Rate	-	-	2.0	%
	Population	123,611	126,420	127,623	1000 person
Sector	Energy Services	1990	1998	2010	Unit
Industrial	Crude Steel Production (Iron & Steel)	111,710	90,979	96,510	1000 t
	Ethylene Production (Chemicals)	5,810	7,076	6,660	1000 t
	Cements Production (Cements & Ceramics)	86,849	80,609	82,790	1000 t
	Paper & Paperboard Production (Paper & Pulp)	28,086	29,886	33,740	1000 t
	Metal & Machinery	56,470	68,170	93,462	Billion Yen
	Non Ferrous	2,384	2,150	2,717	Billion Yen
	Textile	2,514	1,650	1,291	Billion Yen
	Foods & Tobacco	12,322	12,510	13,398	Billion Yen
	Others	23,324	20,210	19,504	Billion Yen
	Agriculture Forestry & Fisheries	1,920	9,270	8,104	Billion Yen
	Mining	1,120	890	786	Billion Yen
	Manufacturing	43,430	39,330	44,972	Billion Yen
Residential	Household	40,670	45,466	49,142	1000 Household
	Room Air Conditioners	1.27	2.01	3.22	per Household
	Refrigerators	1.19	1.21	1.24	per Household
	Lights	3.68	3.98	3.95	per Household
	Color Television Sets	2.01	2.24	2.77	per Household
Commercial	Office & Buildings	313,000	422,000	542,700	1000 m ²
	Whole sales & Retails	299,000	365,000	457,000	1000 m ²
	Restaurants	50,000	60,000	73,400	1000 m ²
	Hotel & Inns	77,000	92,000	44,300	1000 m ²
	Hospitals	65,000	83,000	100,700	1000 m ²
	Schools	311,000	337,000	376,000	1000 m ²
	Theater & Amusement places	24,000	32,000	44,300	1000 m ²
	Department store & Supermarkets	15,000	22,000	34,000	1000 m ²
	Others	146,000	177,000	200,000	1000 m ²
Transport (Passenger)	Passenger Vehicle Stock	35,151	49,180	61,081	1000 Cars
	Passenger Vehicle km Traveled	-	396,252	437,425	Million km
	Volume of Transportation by Rail	385,364	395,213	400,000	Million passenger-km
	Volume of Transportation by Internal navigation	6,275	5,369	5,000	Million passenger-km
	Volume of Transportation by Air	51,624	73,243	102,000	Million passenger-km
Transport (Freight)	Freight Vehicle Stock	-	18,542	19,033	1000 Cars
	Freight Vehicle km Traveled	-	235,099	240,115	Million km
	Volume of Transportation by Rail	27,196	24,618	26,000	Million t-km
	Volume of Transportation by Internal navigation	244,546	237,018	237,000	Million t-km
	Volume of Transportation by Air	799	981	1,000	Million t-km

(Source: Katsuta, 2001)

Table 3. 6: Assumed efficiency improvement

Sector	Measure	Assumption
Residential	Energy Efficiency of Room Air Conditioner	Energy Efficiency : 1252.6→850.0 kWh/year
	Energy Efficiency of Refrigerator	Energy Efficiency : 595.3→300.0 kWh/year
	Energy Efficiency of Lights	Energy Efficiency : 179.7→150.0 kWh/year
	Energy Efficiency of Color TV Set	Energy Efficiency : 177.0→135.0 kWh/year
	New Hot-Water-Supply System	16% reduction of LPG, Town Gas
	Change burner direction to inside	Energy Saving : 6.58kcal/Household
	Reduction of electricity for stand-by system	Electric Power Consumption : 270 →27 kWh/Household/year
Commercial	Home Energy Management	20% Reduction of Energy in House
	Acievement of Standards for Energy Saving Law	Reduction of Electricity : 12%, Introduction rate : 100%
	LED Traffic Lights	508.1kWh/Light, Introduction rate : 100%
	Emergency Light	153.3kWh/Light, Introduction rate : 70%
	Use of Retained heat for Hot Water Supply	10% Reduction of Energy
	Use of latent heat for Hot Water Supply	15% Reduction of Energy
	New Type of Elevator	Reduction of Electricity : 75%, Introduction rate : 50%
	Vending machine	Reduction of Electricity : 55%, Introduction rate : 100%
	High efficient transformer	Energy Saving : 216 GWh/year, Introduction rate : 80%
	Plant Greens in City	Introduction Area : 1.25x1.04 ha
	Plant Greens in Roof	Introduction Area : 6x10 ⁶ m ²
	Micro Gas Turbine	Introduce of 90,000 Turbine (100kW Type)
Transportation	Building Energy Management	20% Reduction of Energy in House
	Improvement of mileage	Reduction of energy : 20%
	Engine Stop in Standing	Stop to engine of 5 min./day
	Shift of usage from car to Bus	Reduction of car usage : 7%
	Shift of usage from car to Rail	Reduction of car usage : 9%
	Change to Walk or Bicycle	For usage of from Home to Station
	Rail	Reduction of energy : 7%
	Air	Reduction of energy : 7%
	Electronic Toll Collection System	Reduction of energy : 13%
	Teleworking	3800 Million km of Reduction
Industrial	Use of Light Vehicle	Commutation of 20% to Light Vehicle
	Production of Irons & Steel	Reduction of Unit consumption : 4.41→4.14 Gcal/t
	Production of Chemicals	Reduction of Unit consumption : 7.82→6.65 Gcal/t
	Production of Ceramics & Cement	Reduction of Unit consumption : 0.90→0.86 Gcal/t
	Production of Paper & Pulp	Reduction of Unit consumption : 3.52→2.99 Gcal/t
	Co-Generation System	Introduction rate : 10%
	Convined Cycle Auto Generation	Introduction rate : 30%
	High Performance Industrial Furnace	Commutation : 30%,
	District Heating and Cooling System	Use of the Waste heat from factory, power plant
	Optimum control using the Inverter for water supply plant	50% of pump : Invertor control
	Optimum control using the Inverter for a sewage disposal plant	50% of fan : Invertor control
	Optimum control using the Inverter for a blower	30% of blower : Invertor control
	Energy Saving for a small-medium business establishment	Energy Saving : 8.5 %/establishment
	Micro Gas Turbine	Introduction rate : 50%

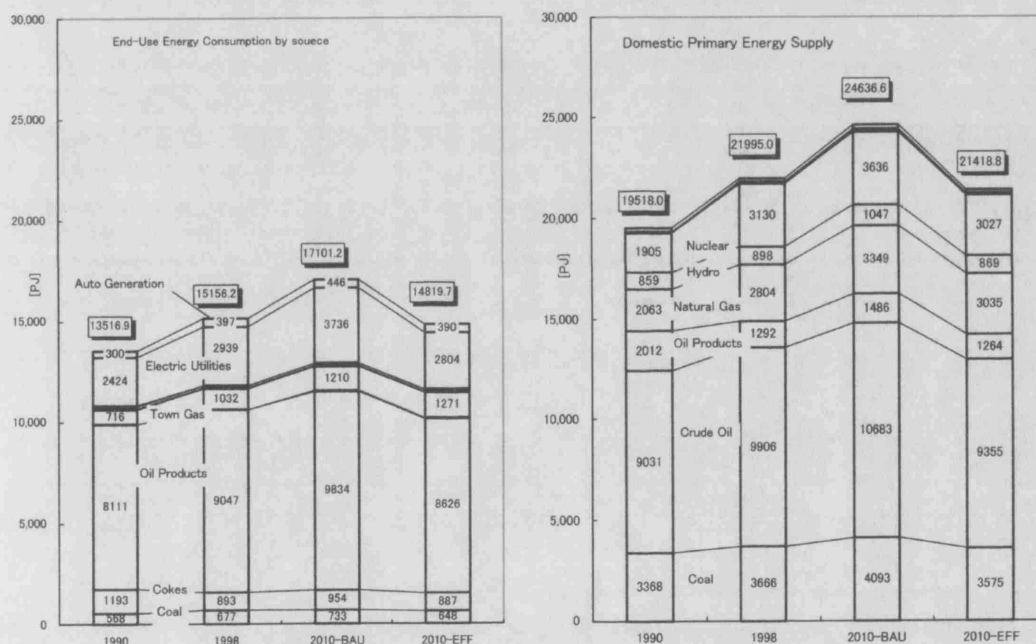
(Source: *ibid.*)

3.2.6.3 Study Results

The result of the simulation is demonstrated as Figure 3.7 and 3.8. The 2010 BAU result represents the situation where the energy demand level is maintained as the 1990-1998 level whereas the 2010-EFF result considers the different technological and life style assumptions.

The BAU result shows significant increase in energy demand, especially on electricity, whilst in the EFF case energy demand level is considerably decreased. As the final demand decreases, primary requirement is also reduced.

Figure 3. 7: End-use Energy Consumption by Sources Figure 3.8 Domestic Primary Energy Supply



(Source: *ibid.*)

The feasibility of nuclear phase-out is considered in the following steps:

1. The electricity demand reduction of 170 billion kWh is achievable through

the above consideration, which is half the total of the nuclear power production in 1998 amount to 330 billion kWh,

2. Assuming the maximum nuclear plan life span is 30 years, the electricity production from nuclear power will be about 210 billion kWh.
3. The difference between 330 and 210 is 120 billion kWh.
4. The 120 billion kWh can be satisfied by renewable energies such as solar and wind (of which potentials are identified as 270 billion kWh and 185 billion kWh respectively).
5. The study also establishes 2010-EFF-RE case where efficient use of LNG and the mixed use of biomass and coal to deliver CO₂ reduction.
6. The study result demonstrates the deployment of some energy efficiency technologies and demand management can bring the significant energy demand reduction.

The combination of energy demand reduction and deployment of innovative technologies enables the phase-out of dangerous and expensive energy technologies.

3.2.6.4 Critical Review

1) The types of study: Qualitative vs. Quantitative?

The study is clear and concise simulation which is mindful of the potentials of energy demand management. It is not only taking some purely technological assumptions, but also non-technical options such as modal shift and energy demand reduction into consideration.

2) The nature of the study: Trend following or trend breaking?

As the desirable state of energy supply demand structure is proposed, this study is implicitly trend breaking. In other words, it is effectively a feasibility analysis of the desirable future, using the style of numerical simulation.

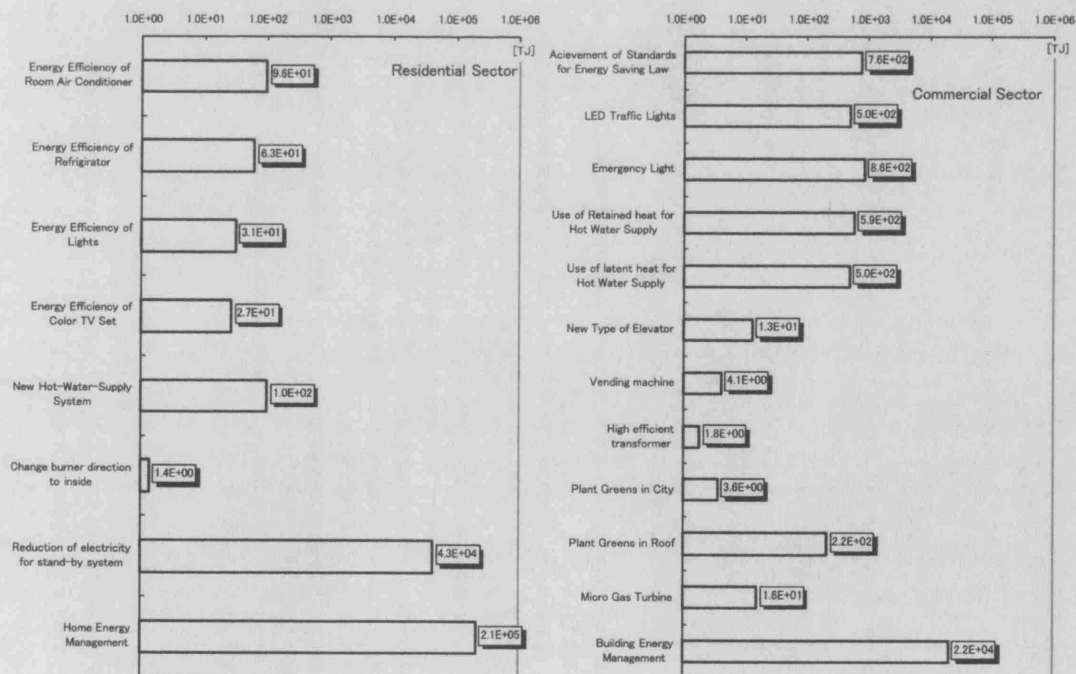
3) The Definition of *Scenario*

In the study, the term "*scenario*" represents the combination of the energy options and fuel structure change. The study deals with the relatively short period up to 2010. This inevitably affects the scope of the study to preclude the identification

of longer-term options.

As is the case with other simulations, the study's options are those directly related to energy demand reduction, and not cover the *indirect* options (carbon tax, for example) which could trigger the *direct* options. The fact that the *indirect* options are not covered is the major setback of the study, because that makes difficult to determine which actions need to be implemented to achieve the desirable future.

Figure 3. 6: CNIC estimate for individual options' effectiveness



(Source: *ibid.*)

3.3 Concluding Remarks

This chapter reviewed several "*scenarios*" in Japan from some critical perspectives, so that the position of this research in the existing studies to be clearly recognised. This section first introduces one of the surveys carried out by the EEA, which identified major characteristics of "scenarios", and categorised some of the key studies based on the characteristics. The EEA classification will be a useful benchmark to review the number of similar studies in Japan.

The EEA study classifies several researches by 1) qualitative or quantitative and 2) anticipatory or exploratory differences (European Environment Agency, 2001). It then illustrates five major exercises taken mainly in the European context (Table 3.7).

Table 3. 7: Examples of scenario studies

Scenario name Theme	Types of scenarios (qualitative or quantitative)	Types of scenario (anticipatory or exploratory)	Number of scenarios	References
European Commission "Scenarios Europe 2010"	Qualitative	Anticipatory	5 Combined baseline & policy	Bertrand et. al., 1999
IIASA "Future environments of Europe"	Combined	Anticipatory	Approx.4 Combined baseline & policy	Stigliani et. al., 1989
IMAGE "Global change"	Quantitative	Exploratory	3 baseline 14 policy	Alacamo et. al., 1996a Alacamo and Kreileman, 1996 Leemans et. al., 1996
SRES (IPCC) "Global greenhouse gas emissions"	Combined	Exploratory	4 baseline scenario "families"	Nakicenovic et. al., 2000
World water vision "The world water situation"	Combined	Combined	1 baseline 2 policy	Cosgrobe and Rijsberman, 2000 Alacamo et. al., 2000

(European Environment Agency, 2001)

A qualitative scenario is defined here as those “describe possible futures in the form of words or visual symbols, rather than numerical estimates”, while the quantitative scenario is to “provide needed numerical information in the form of tables and graphs”. The difference between anticipatory and exploratory scenarios is that exploratory scenarios “begin in the present and explore trends into the future”. Anticipatory scenarios “start with a prescribed vision of the future” and

“work backwards in time to visualise how the future could emerge” (*ibid.*).

The following table is to describe the various scenario studies carried out in Japan, which were introduced in this chapter. The table illustrates these scenarios in the same categorisation with the EEA manner (Table 3.8).

Table 3. 8: Japanese scenarios

Scenario name Theme	Types of scenarios (qualitative or quantitative)	Types of scenario (anticipatory or exploratory)	Number of scenarios
Ministry of Environment Japan (MoE)	Combined	Exploratory	4 baseline scenario families
Citizen's Alliance for Saving the Atmosphere and the Earth (CASA)	Combined	Anticipatory	1 baseline 1 government 2 policy
World Wild Fund Japan (WWF Japan)	Quantitative	Anticipatory	1 baseline 2 policy
The Japan Initiative (TJI)	Qualitative	Combined	3 scenario families
Research Institute of Innovative Technology for the Earth (RITE)	Quantitative	Exploratory	3 "assumptions"
Citizen's Nuclear Information Center (CNIC)	Combined	Anticipatory	1 policy
This research	Qualitative	Anticipatory	1 baseline 3 policy

The primary purpose of these existing studies is to demonstrate feasibility of CO₂ reduction. Their intention is generally to persuade the government, the industry and the public to recognise that it is possible to reduce CO₂. On the other hand, some of them tend to over-emphasise technological options, while non-technological elements (e.g. financial aspects) are largely ignored.

Technological options certainly play significant roles in CO2 emissions reduction, but wider elements, such as pricing and regulation also need to be considered, as they would make the technological options available.

In contrast, this research is based in the “backcasting” theory, and can be classified into the “qualitative” scenario type, and this research is in line with the anticipatory scenario defined by the EEA. Overall, the combination of qualitative and anticipatory character, which is represented by the research, is not preceded in the context of Japanese scenario studies.

The qualitative + anticipatory combination would have an advantage of presenting the steps necessary to be taken to achieve a specific future, and this advantage would be distinctively useful in the policy planning context. With this point in mind, this research places its goal to construct policy paths linked with images of the future. Policy paths are consisted with policy options embracing extensive categories including financial, social and technological entries.

Chapter 4: SCENARIO MODELLING

4.1 Aim and Main Issues

As examined in Chapter 3, conventional energy policy studies in Japan are rather falling short of responding to the new challenge, to bring systematic and strategic methods to recognize critical steps for reaching a normative future. Also, as seen in the Chapter 3, there are confusingly many notions attached to the term “scenario” in those existing studies.

The objective of this chapter is to build scenarios that help achieving the sustainable energy policy, and to demonstrate a conceptual framework behind the scenario building. This chapter first elaborates the definition of scenario and its implication to this study.

4.1.1 Definition of Scenario and the Applied Scenario Methodology

In this study, “scenario” is “strategic synopsis which describes chronological development of future actions, and is clearly distinct from forecasting. It is rather a learning process, than a tool to “predict” futures. In this sense, the meaning of

the “scenario” here is not far from what is defined as the “External Scenario” by van der Heijden as “*representative of the ranges of possible future development and outcomes in the external world*” (van der Heijden, 1996).

External scenarios are derived from shared and agreed upon mental models of the external world. They are created as internally consistent and challenging descriptions of possible futures. They are intended to be representative of the ranges of possible future development and outcomes in the external world. What happens in them is essentially outside of our own control.

At the same time, identification of the external contexts requires mental preparation to adapt to the context.

Internal scenarios belong to a person and relate to his/her anticipation of future states of the interactional world, as it relates to the 'self'. They are less complete but are almost by definition, internally consistent. An internal scenario is a causal line of argument, linking an action with a goal. They person will lead to play a role in his/her own internal scenario. It can be seen as one path through a person's cognitive map (ibid.).

Thus, the internal scenario will also be required as a cognitive response to the external scenario. In this sense, the external and internal scenario complement each other. Combining them is important, as the external scenario relates to uncertainty, under which internal cognitive map to respond to the uncertainty is required. The cognitive response will be most likely formed in a backcasting way by linking a goal with actions, instead of linking actions with a goal (If I do this, I can achieve that→In order to achieve that, I have to do this now.)

In terms of the definition of “scenario” and the overall methodology for assembling the scenario, this study will be broadly based on the challenge taken by the POSSUM consortium, to “combine” scenario and backcasting (Banister, 2000). The contextual framework, based on the external scenario, will be used to shape Images of Future (in this study, this will be called “the Visions”)¹.

Based on the POSSUM study, the main elements in this study are broken down

¹ The value of the backcasting methodology in the Japanese energy policy has been already mentioned in the Chapter 1, and will not be repeated here, but the implication of the methodology is widely recognised as a means to propose robust steps for desirable solutions to a major societal problems.

into the following five stages:

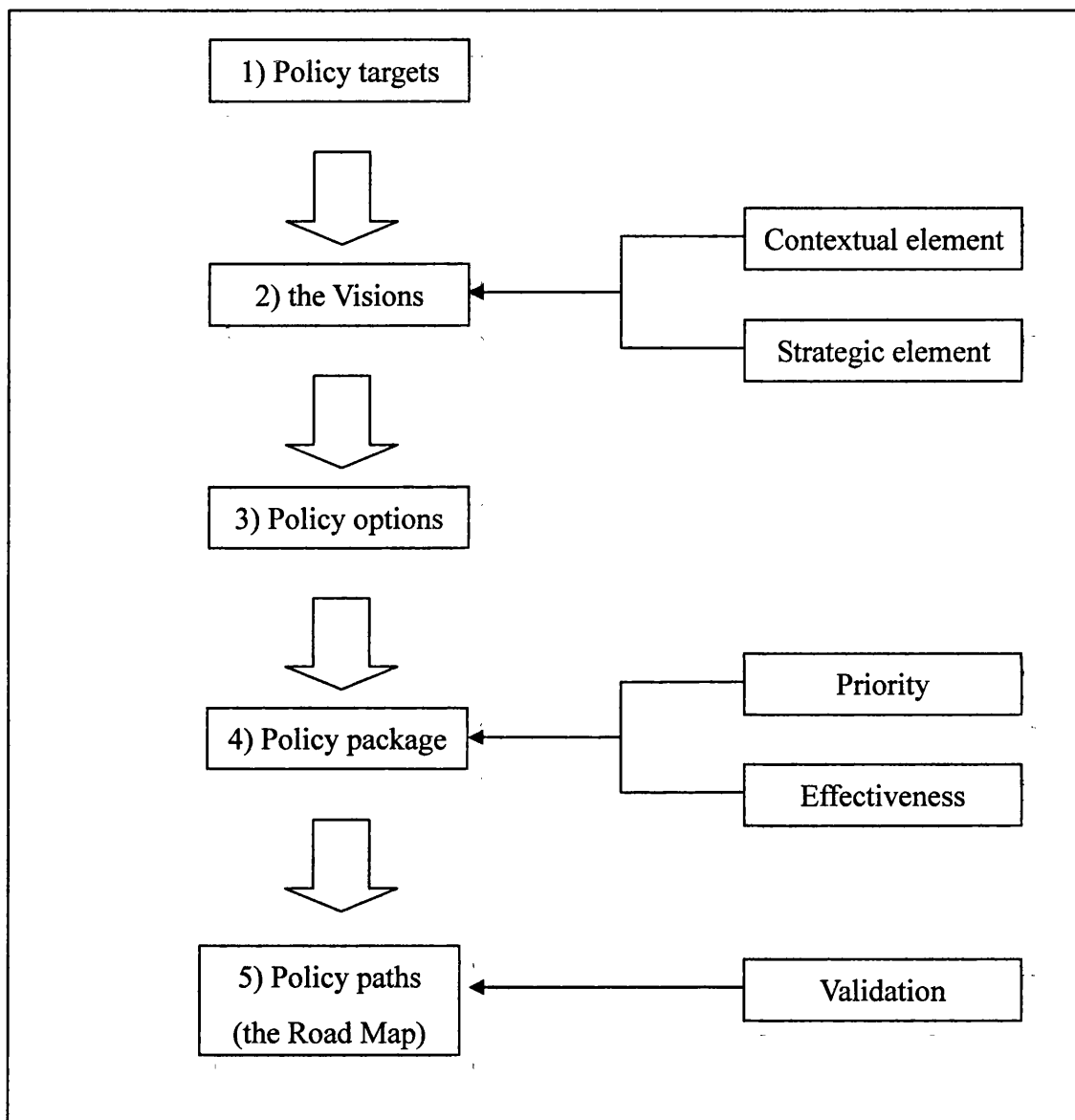
1. Policy Targets
2. Images of the Future (the Vision I/II/III/IV)
3. Policy Options
4. Policy Packages
5. Policy Paths (the Road Map)

In the next section, the main five stages are explained in details.

4.1.2 The 5 Main Stages

The Figure 4.1 demonstrates overall flow of the study methodology.

Figure 4. 1: Flow of the study



1. Policy targets

They are to provide the overall directions to shape the Images of the Future (which are called the Visions in this study). Although there could be many indicators to measure sustainability of an energy policy, three main issues are to be emphasised: environmental sustainability (through pollution/waste reduction), economic viability and social equity.

2. Images of the Future (the “Visions”)

They are made up with “contextual elements” and main “strategic decisions” to represent a societal feature at an indicative year (2030 in this study). There are also external elements, which are the factors as given, and are not supposed to change over time, or to change in a consistent pattern.

3. Policy Options

Policy options are the instrument to achieve policy targets. There are a wide scope of policy options available, and they are categorised in several headings in this research, such as infrastructure, market, and information strategies.

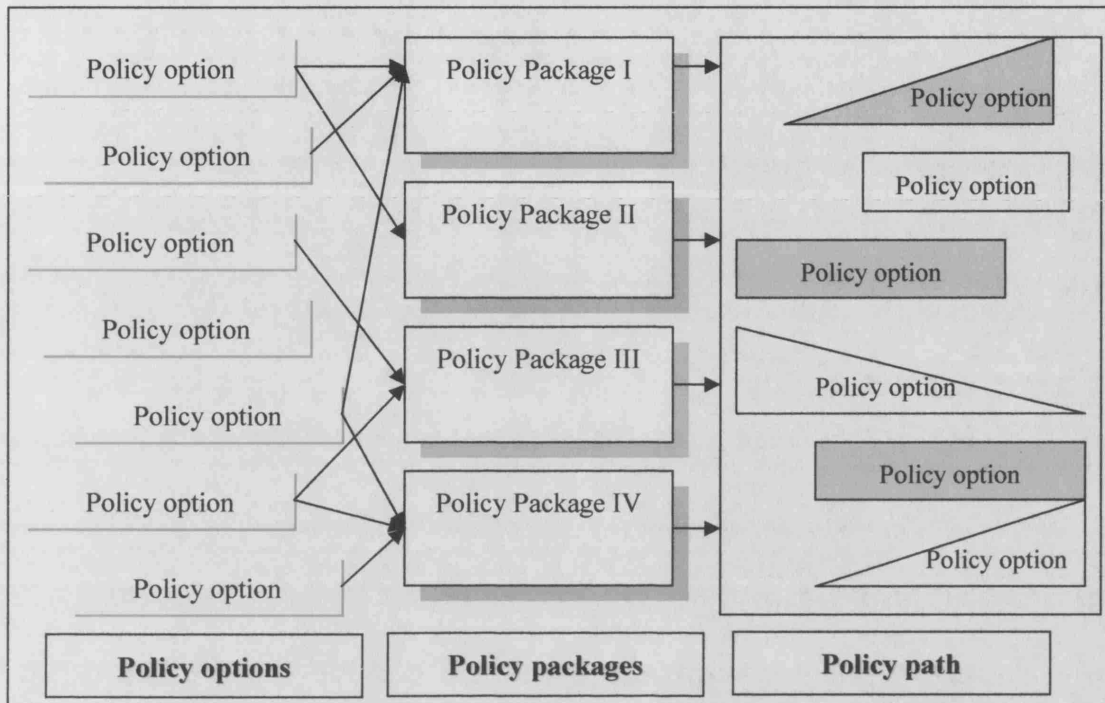
4. Policy Package

A policy package in this study is a group of policy options thought to be required to reach to a particular “Vision”. Backcasting method will provide useful framework to identify not just a range of necessary policy options, but also the timing to introduce them to optimise their synergetic effects. Policy options are evaluated by a range of energy policy experts from the priority and effectiveness aspects.

5. Policy Paths (the “Road Maps”)

The policy path in this study is the cognitive map made up with the internally consistent sequence of the packaged policy options, starting from the present to the future. The Figure 4.2 explains the fundamental flow linking policy options, policy packages and policy paths.

Figure 4. 2: Flow diagram, linking policy options, policy packages and policy paths



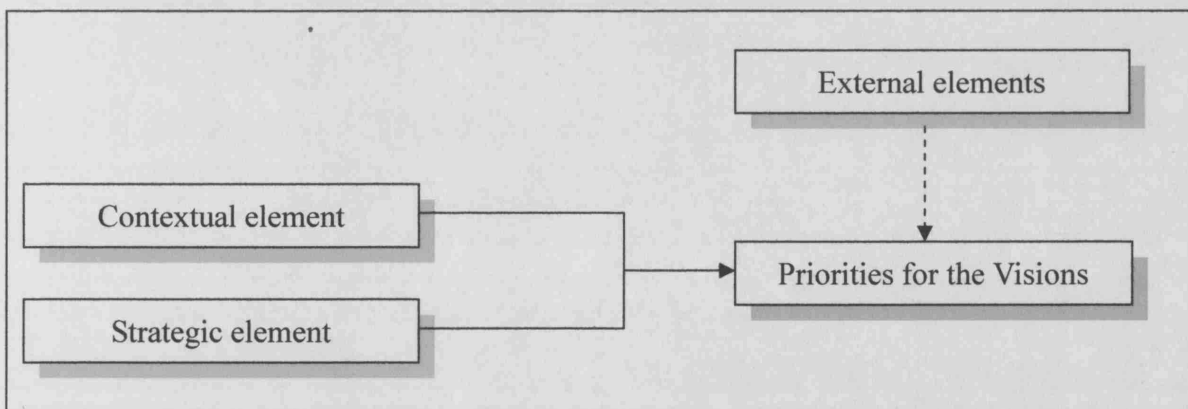
4.1.3 Choice of Images of the Future (the Visions)

The purpose of scenario planning is to generate decisions which are robust under a variety of alternative futures (van der Heijden, 1996). In order to imagine alternative futures, contextual elements are considered as underlying directions society implicitly agrees to head for. The contextual elements in this study are based on the assumptions on the degree of sustainability that a society is directed. The degree of sustainability, ranging from very weak to very strong sustainability, will be elaborated in the section 4.4. The uncertainties and external elements, e.g.

accidents, fluctuation of energy prices, that a national strategic decision can not directly influence upon, are not featured in the Visions, though many examples of the external elements are identified (Section 4.3).

There are 4 main strategic issues which affects the probability of achieving the targets by 2030. The details of those elements will be elaborated in the Section 4.5, but they are broadly identified as: 1) Economy, 2) Inter-resources change, 3) Technology, 4) Lifestyle change.

Figure 4. 3: Flow for creating Visions



The flow of creating Visions can be summarised as the Figure 4.3, where contextual and strategic elements are combined to represent different priorities for the Visions. The identified priority is instrumental to the features of Visions. The table 4.1 summarises the priorities for the Visions.

Table 4. 1: Priority identification

Strategic \ Contextual	Very Weak Sustainability	Weak Sustainability	Strong Sustainability	Very Strong Sustainability
Economy	✓			
Inter-resource change		✓		
Technology			✓	
Lifestyle change				✓

There are 16 combinations, but the nature of the contextual and strategic elements logically excludes many of them. For example, the Very Weak Sustainability strongly emphasises the maintenance of the current economic size and level, thus it does not demand a fundamental change, as some other contextual elements would do. In the same way, the Weak Sustainability's managerial position prefers technical solutions, e.g. inter-resources change, rather than more drastic solutions. The Strong Sustainability stresses much tougher commitment to the decoupling between economy and the environmental performances. The study made an assumption that the decoupling would be probably carried out through technological development. Finally, the Very Strong Sustainability demands considerable degree of societal shift, involving change of the people's lifestyle.

Based on the above priorities and features, Vision outline is created as the Box 4.1

demonstrates:

Box 4. 1: Vision Outline

Vision I is a business-as-usual case, in which Japan increases its energy demand that is supported mainly by thermal powers. Marginal level of demand management is carried out in the domestic, commercial and transport sectors.

In Vision II, Japan relies on imported energy on a massive scale. Demand management has given a little significance in this Vision, with equally little emphasis is placed on technological development for renewable sources.

There is a massive deployment of technologies in the Vision III. However, decrease in demand level in the Vision III is minimal. It creates a contrast with the Vision IV where renewables equally plays an important role, while the demand level is significantly lower as a result of massive demand management.

Table 4.2 summarises the Vision feature with clear label for each.

Table 4. 2: Priority identification

Contextual Strategic	Very Weak Sustainability	Weak Sustainability	Strong Sustainability	Very Strong Sustainability
Economy	BAU			
Inter-resource change		Gas Japan		
Technology			Renewable Emergence	
Lifestyle change				Ecological Footprint

4.2 Linking the Visions and Targets

The Visions created above form the basis for more specific targets. Since it is essential for scenario analysis to establish policy path to reach the targets from the current situation, the targets should be described numerically as possible to make quantitative assessment possible.

Setting the target requires consideration on how much deviation will exist from a particular benchmark point. It is therefore necessary to decide with which benchmark point those deviations should be compared. For example, it is possible to compare deviations with the current energy demand-supply structure. On the other hand, it is also conceivable to compare the deviations with the situation when things go as business-as-usual. Against the background of UNFCCC discussions where the reduction of GHGs from 1990 level is a particular concern, the former type of comparison seems to fit to the purpose of this thesis, which is hopeful to be along the line with UNFCCC debates.

In the following sections, the Japanese energy demand-supply structure is reiterated with some new perspectives. For demand side, a particular emphasis is placed on different forms of energy and their associated qualities, with possible

demand reduction on each forms of energy. Supply side analysis will then follows for each Vision. The each path is, then, going to be presented individually. This does not, however, suggest the paths are mutually exclusive: there are many elements to be shared by several paths, especially those which are potentially indispensable upon linking the Visions and the *status-quo*. Thus the grouping of a path should be seen as indicative, rather than definitive.

This research is highly aware of the risks and dangers associated with nuclear power production, especially in Japan where successions of scandals involving utilities undermined the credibility of the nuclear safety². One of the main principles of this research is to seek the nuclear free future for Japan. This is along the line with the development in the other developed countries, such as the UK, where the 2003 Energy White Paper stands on the assumption not to rely on nuclear for the country's energy production (UK Dti, 2003).

² For example, a revelation was brought on August 2002 that the Tokyo Electric Power company (TEPCO) was involved in the series of falsification of nuclear inspection record, which became a big scandal in Japan. As a result, the company was forced to close some of its nuclear plants for special inspection. Further information is available at:
[http:// www.cnrc.or.jp/english/news/misc.tepcofalse.html](http://www.cnrc.or.jp/english/news/misc.tepcofalse.html)

4.2.1 Identification of Demand and Supply of Energy

In this section, the procedure to link Visions and its detailed assumptions of the Visions are illustrated.

It involves the following main stages:

- 1) Establish the co-relation between the Visions and scenario assumptions:
Scenario assumptions to be set as numerical targets
- 2) Identify the energy demand-supply structure at the benchmark point
(with attention paid to demand for different energy forms)
- 3) Numerical targets for each Vision's demand reduction to be established
against the benchmark level
- 4) Demand level for different forms of energy is calculated under the
Visions and their assumptions.
- 5) Identify how the Visions will affect energy supply, especially in terms of
the amount of development for different energy sources.
- 6) The final demand and the estimated energy supply to be compared to
ensure that they are balanced
- 7) Estimate emission levels under different Visions

The benchmark point is established as 1999 level when the complete set of energy data is available in Japan.

4.2.2 Scenario Assumptions

The first step is to link the Visions and the scenario assumptions. Based on the Vision outline (Box 4.1), fundamental energy demand-supply assumption was made.

Box 4. 1: Vision Outline (repeated)

Vision I is a business-as-usual case, in which Japan increases its energy demand that is supported mainly by thermal and nuclear powers. Marginal level of demand management is carried out in the domestic, commercial and transport sectors.

In Vision II, Japan relies on imported energy on a massive scale. Demand management has given a little significance in this Vision, with equally little emphasis is placed on technological development for renewable sources.

There is a massive deployment of technologies in the Vision III. However, decrease in demand level in the Vision III is minimal. It creates a contrast with the Vision IV where renewables equally plays an important role, while the demand level is significantly lower as a result of massive demand management.

The Table 4.3 summarises the scenario assumptions for each Vision.

Table 4. 3: Visions and Scenario Assumptions

Vision I	Business as usual (BAU)	Demand increase Small contribution from renewables
Vision II	Gas Japan	Demand increase Fuel switch from GHG intensive fossil fuel and nuclear to less GHG intensive fossil fuel.
Vision III	Renewable Emergence	Little demand reduction Large contribution from renewables
Vision IV	Ecological Footprint	Large demand reduction Contribution from renewables

The Table 4.3 can be translated into the following schema (Table 4.4) which is describing the strength of change required for the energy supply-demand structure.

Table 4. 4: Strength of change required

	Supply - non-renewable	Supply - renewable	Demand
Vision I	+++	+	+++
Vision II	++	+	++
Vision III	+/-	+++	+
Vision IV	--	+++	-

As for the future of nuclear contribution, it is important to consider its share in the present energy supply structure. The contribution of nuclear has been often

exaggerated in Japan's energy debates: it is widely argued by the government and utilities that the share of nuclear is over 30% in the electricity supply, hence, the nuclear phasing out does not have a ground. The share of nuclear, however, in the whole energy supply is about 7%. Having regard to the small contribution of nuclear energy, the gradual replacement of nuclear with other sources is not unrealistic as commonly believed³.

In the scenario modelling, the assumption was made that the share of nuclear will be highly limited. Under the Vision I, where the government push for the nuclear is expected to continue, some increase of nuclear deployment is expected. Many of nuclear power stations currently in use, however, will not be replaced by new nuclear instalment, because of the financial burdens associated with the whole nuclear programmes. The total number of nuclear instalment in 2030 will, therefore, be significantly lower than those of today.

The similar picture applies to the Vision II, where inter-fuel exchange did not

³ In August 2002, the Tokyo Electric Company admitted false records on nuclear maintenance. This grew in to a scandal, made all of the company's executives resigned. As a response to the scandal, TEPCO temporally closed nearly all of its nuclear power stations. The TEPCO, and other utilities assured the public that there are more than sufficient power production capacities available, to fill the gap between power supply and demand, though the replacement of nuclear with fossil fuel uses increased the CO2 emission volume.

bring the fundamental change to energy supply philosophy, maintains some level of nuclear development, but the degree of the new deployment severely restricted.

Under the Visions III and IV, the presumption of new technology development and energy demand reduction is to replace fossil and nuclear fuels with other forms of energy sources. The nuclear share under these two Visions will be replaced with renewable energy use and extensive energy management.

4.2.2.1 CO2 target, demand/supply structure change

Numerical targets for each Vision's CO2 reduction are established against the level in 1999⁴ to test a match between energy supply and demand. These targets are obtained by iteration, with the constraints given in terms of CO2 targets, broadly based on the different assumptions are described in the Table 4.3: Scenario I with minimum increase in renewables contribution. Scenario II with inter-fossil fuel change. Scenario III and IV with increase from renewable contributions⁵.

⁴ The year 1999 was taken as a baseline as it is the most recent year the statistics was available at the time of writing.

⁵ Vision I is BAU and its CO2 target is established based on the current trend.

A particular attention was paid to ensure, not only the official UNFCCC target figures, but also other environmental concerns are taken into consideration upon creating the CO₂ reduction target. For example, Japan must reduce its CO₂ emission by 85% by the end of 21st century, though the reduction does not necessarily have to be “linear”: the reduction rate can be variable, depending on the cost and acceptability of the available policy measures. (Thus in Vision I, the CO₂ increased by 2030, but it does not mean the increased trend will continue after 2030. This suggests that there has to be substantial CO₂ reduction after 2030). The research establishes the CO₂ reduction target as follows, with taking into these issues account:

Table 4. 5: CO₂ target by 2030

	Vision I	Vision II	Vision III	Vision IV
Against 1999	103%	84%	78%	65%
Against 1990	112%	91%	84%	71%

The level of targets for some Visions may not look challenging enough, especially for the Vision I and the Vision II, where contextual elements define weaker readiness of the Japanese government, the industry and the society to accept the drastic change. On the other hand, tougher targets were selected for the Vision III and IV where stronger environmental paradigms are identified. The weaker targets,

however, do not preclude the possibility for Japan to establish much more stringent targets for later stages than 2030.

In order to achieve the above CO₂ target, the primary energy increase/decrease targets are contrived. Table 4.6 demonstrates the target for energy supply change.

Table 4. 6: Primary Energy Target by 2030 (by sector)

	Vision I	Vision II	Vision III	Vision IV
Industrial	110%	90%	90%	80%
Household	110%	100%	90%	80%
Commercial	110%	100%	90%	80%
Transport	120%	110%	100%	80%
Others	100%	100%	100%	100%
Average	110%	100%	94%	84%

The primary energy share by fuel to achieve the target in Table 4.5 to be postulated as follows.

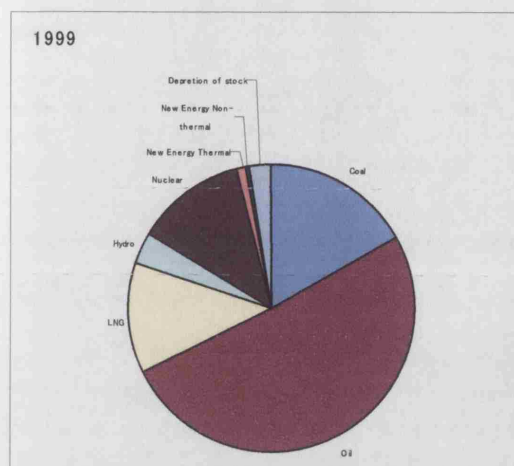


Figure 4. 4: Primary energy share by fuel (1999)

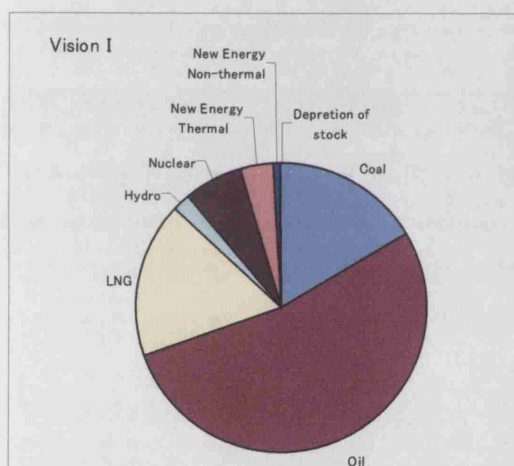


Figure 4. 5: 2030 Vision I

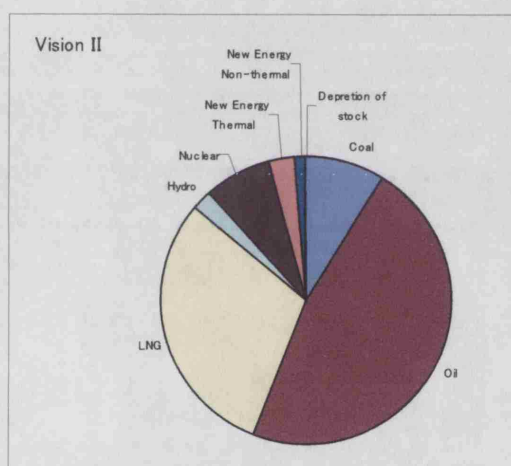


Figure 4. 6: 2030 Vision II

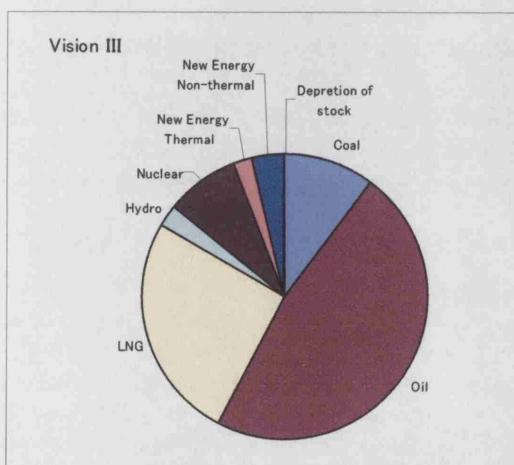


Figure 4. 7: 2030 Vision III

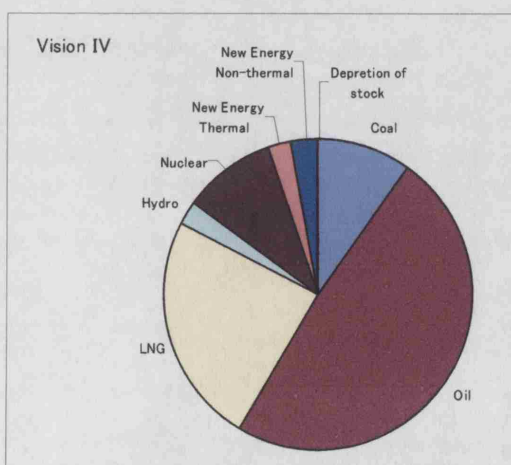


Figure 4. 8: 2030 Vision IV

The figures 4-4 to 4-8 demonstrate a breakdown of changes for each energy sources. Under the Vision I (shown in Figure 4.5) changes will be along the line with the government BAU forecast, which is targeting at minimum renewable introduction and ambitious nuclear deployment.

It is important to assess if the assumed energy supply matches the demand. The final demand and the estimated energy supply are compared to ensure their balance. Thus, final energy consumption increase/decrease against 1999 to be assumed as Table 4.7. As is the case with supply, the energy demand target is established under the Visions and their assumptions.

Table 4. 7: Final energy consumption increase/decrease against 1999

	Vision I	Vision II	Vision III	Vision IV
Coal	100%	90%	80%	70%
Oil	110%	100%	90%	80%
LNG	110%	120%	120%	120%
Town gas	110%	120%	120%	120%
Renewable energy (Thermal/heat)	100%	200%	100%	100%
Renewable energy (Non-thermal/heat)	500%	500%	1000%	800%
Electricity	130%	110%	110%	80%
Hydro power	130%	120%	130%	110%
Thermal power	145%	120%	110%	80%
Coal	160%	20%	45%	30%
Oil	200%	20%	50%	30%
LNG	140%	240%	180%	130%
Autoproducers	110%	110%	110%	90%
Nuclear	45%	45%	45%	45%
Renewable energy	600%	300%	600%	400%
Thermal	700%	300%	270%	260%
Non-thermal	400%	400%	9000%	4000%
Others	100%	100%	100%	100%

The final energy consumption increase/decrease is linked to the CO₂ target in

Table 4.5. The detailed calculation is given in Appendix C.

In summary, "shallow-green" sources, such as industrial bio-waste and municipal solid waste combustion dominate the total growth of renewable development in the Vision I. On the other hand, Nuclear increases its share, so does fossil fuel combustion.

In the Vision II, the similar picture with the Vision I will be applicable, as the main change concentrates on inter-fossil fuel exchange. Overall fossil contribution grows under the Vision, reflecting the assumption that the demand reduction is not available.

The Vision III sees the significant increase in renewable energy sources. Wind energy, and its integration with other supportive mechanisms help the competitiveness and effectiveness of renewable energy use, pushing the cost of renewable energy and their supportive mechanisms further downwards. Industrial bio-fuels are less dominant in the total renewable share. The co-generation and fuel cells are, however, not widely adopted, because of monopolistic market conditions seen today remains intact.

The fuel cells and co-generation are more widely available in the Vision IV, or in other words, they are the key energy supply technologies in the fully liberalised market under the Vision IV. Renewable energy plays a key role to supply electricity to users, as well as they provide electricity to produce hydrogen to be used in fuel cells. Biomass, including industrial bio-fuels and sewage gas, becomes the important source of hydrogen.

The new types of energy sources, thus, gradually replace fossil fuel and nuclear contribution. The demand reduction assumed under the Vision IV helps meeting demand with the new energy source arrangement.

These numerical presentations are to give clear pictures as to what future each Visions represent. These figures will be the basis for the presentation of Visions to experts, and the linking of Visions and policy options will be closely examined by them.

4.2.2.2 Other Environmental Considerations

Targets for other pollutants than CO₂ need consideration along the line with the CO₂ reduction. CH₄, N₂O, HFC, PFC, SF₆ are also the major pollutants contributing to the global climate change. Other substances, such as NO_x, which has significant health implications, and SO₂, which is associated with acidification of the environment, are also the two major pollutants that need to be controlled. Also, the nuclear wastes, to which there is no definite disposal method established, should be managed within a certain level.

Table 4.8 demonstrates the decrease of SO₂ and NO_x experienced from 1978 to

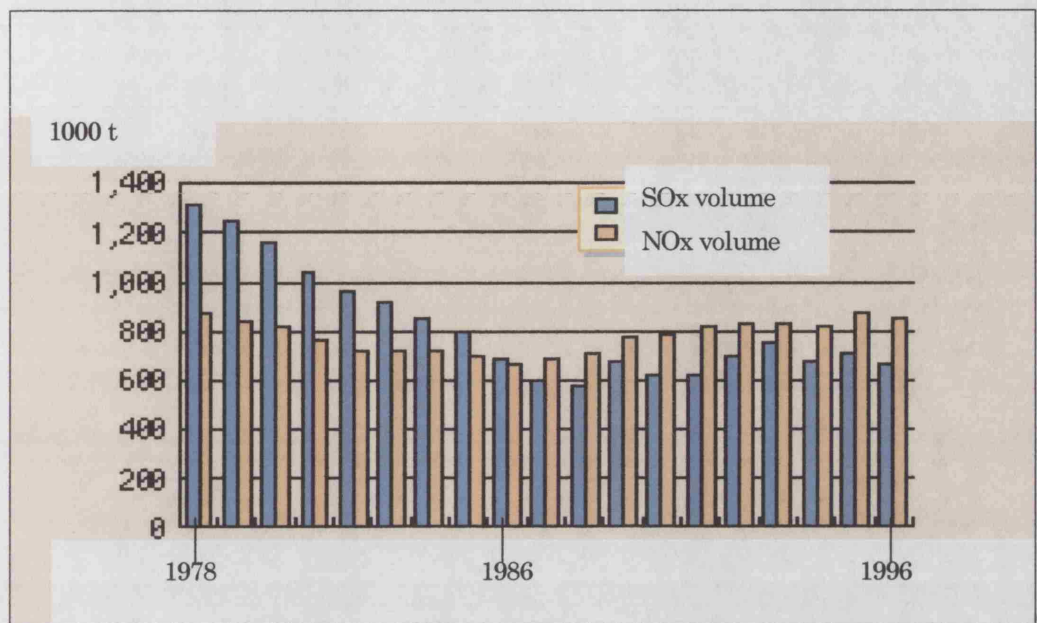
1996. As shown, total emission volume for both substances decreased until around 1986, but not further⁶. Also for the nuclear waste, the amount is expected to rise from 900tU/year in 1998 to 1,400tU/year in 2010 (CNIC, 2000)⁷.

As the main pollutant in this research is CO₂, targets for these substances are not to be established. It does, however, recognises the problems associated with the emissions other than CO₂, in the form of global to local risks, including severe health problems (e.g. cancer from nuclear operation and waste handling), acidification from sulphuric emissions, and respiratory diseases through nitrate pollution.

⁶ Since 1996, the amount of atmospheric pollutants namely NO_x is on the increase, reflecting the fact that many newly constructed thermal power stations are using fossil fuels. This is broadly the result of the privatisation for which only the economic efficiency was the main driving force, taking little environmental concerns into account.

⁷ The data is for spent fuel.

Table 4. 8: SOx and NOx emission volume in Japan



Source: Ministry of the Environment Japan, 2002)

4.2.2.3 Equity and Efficiency Targets

As well as the environmental targets, the equity and the efficiency are keys to the sustainable future, therefore the targets are to be established for them. For example, energy prices in Japan are among the highest in the world, and the reduction of the price is seen to contribute to the people's financial equity.

Also, the people have been largely isolated from the central energy decision-making procedure, to the extent that a limited number of "experts" can

dictate the national and local energy policies. To increase the access of people to energy decisions would likely to contribute to produce social equity.

Therefore, the following two are identified as the equity and efficiency targets:

- Increase market efficiency to reduce the cost currently bore by energy consumers
- Increase social efficiency by enhance public participation to the energy decisions

Box 4.1 summarises the targets covering the environmental, equity and efficiency targets.

Box 4. 2: Environmental, Equity and Efficiency Targets

● Environmental Targets:

- | | |
|--------------|---|
| (Vision I) | 3% increase of CO2 emissions from 1999-2030 |
| (Vision II) | 16% reduction of CO2 emissions from 1999-2030 |
| (Vision III) | 22% reduction of CO2 emissions from 1999-2030 |
| (Vision IV) | 35% reduction of CO2 emissions from 1999-2030 |

● Equity Target:

Increase market efficiency to reduce the cost currently bore by energy consumers

- Efficiency Target:

Increase social efficiency by enhance public participation to the energy decisions

4.2.3 Flexibility of Choice

Since the targets were now developed, the next stage is to link these targets and the current situation by building policy paths. There would be, however, no single policy path between the status quo and the Visions. In other words, although the policy measures are packages to present possible ways to deliver the Visions, flexibility of choice should be taken into account upon their application to the reality.

Flexibility of choice means that it does not necessarily the case that all the sectors have to have the same target. Tougher targets can, for example, be established for the transport sector than the others, if that is technically and financially desirable. It is also the case that one particular energy source can be extensively developed, if there is sufficient reason to do so. Likewise, options can be shared by several paths. In this way, many more than the indicated pathways are conceivable to lead to the future Visions.

The next sections discuss the key components (external elements, contextual elements and strategic elements) in details.

4.3 External Elements

External elements, contextual elements and strategic elements have different degree and types of interaction with the socio-technical energy system model. The external elements is defined as those which the system itself has little managerial power over, whereas the contextual elements determine the overall direction that a society implicitly agrees to proceed towards, and the strategic elements are those on which the system does have its control and influence over. The example of the external elements includes the scale of world economy or the relative strength of its sub-economies that defines each sub-economy's purchasing power for the commodity, e.g. energy fuels. Each subsystem is, thus, influenced by these elements, but it has little capacity to influence. In the following section, examples of the identified external elements are listed.

4.3.1 Global Politics and Economics

There is an ongoing debate as to how the world economic structure should be

organised. An increasingly fierce opposition has been formed against capitalism and its globalisation, as they are the potent elements contributing to the north-south problems. However, although some drastic method could be introduced to change the balance of world power by 2030, the research is based on the assumption that the capitalism will remain as the dominant form of the world economy.

Another assumption is that the global superpower, mostly represented by the US, will use all the measures to secure its current dominance over the fossil fuel acquisition. Many critics argue the US War against Terrorism, a response to the “September 11” attack, was in fact the carefully designed US endeavour to seek access to the Middle East fossil reserves (Aoyama, 2002).

Through the campaign in Afghanistan, the Bush administration was successful in establishing the US sympathetic government in that country, represented by Hamid Karzai, heavily involved in the management of the UNOCAL, an oil giant in California, which has a strong interest in the Middle East energy politics. The US attack in Iraq in March 2003 was regarded by many as motivated to seek oil in the world 2nd largest reserves available in the Iraqi territory (Figure 4.9). This suggests that the “superpower” seems to use all possible measures (including

military power) to secure the currently dominant life-style enjoyed by its population by trying to keep oil prices at the “preferable” level, by acquiring access to the formally inaccessible fossil fuels.

Figure 4. 9 Greatest oil reserves by country 2002⁸

2002 rank	Country	2002 proved reserves (billion barrels)
1.	Saudi Arabia	261.7
2.	Iraq	115.0
3.	Iran	99.1
4.	Kuwait	98.9
5.	United Arab Emirates	62.8
6.	Russia	53.9
7.	Venezuela	50.2
8.	Libya	30.0
	Nigeria	30.0
10.	China	29.5

(Source: U.S. Energy Information Administration, 2003).

In line with the above assumption, the IEA made an estimate that world economy to grow by 3.1% p.a. by 2020, while OECD output rises 2% p.a. The growth rate in the OECD pacific is expected as 1.7% per year by 2020 (IEA, 2000). The

⁸ Figures for Russia are “explored reserves,” which are understood to be proved plus some probable. All other figures are proved reserves recoverable with present technology and prices.

research takes these figures as an overall framework for the analysis.

4.3.2 Energy Prices

Though it is highly uncertain that what factors will disturb energy prices, crude oil import price is assumed to gradually increase. The path, however, may not be smooth, depending on the political, economical and geographical factors affecting the crude oil prices.

Although listed as external elements, the energy prices also have aspect of an strategic element. It is determined in a sense that the Japan has little power to influence, as it is practically decided by the international power balance and the market. On the other hand, it is also an integral part of domestic strategic element, as the energy prices are subject to the national system, such as taxation. The energy price is, therefore, treated in the research as an element whose net prices are external to a country's decision, but the after-tax price is within a sphere of domestic (hence, strategic) decision.

4.3.3 Global and Japanese Demography

Population, which may be influenced by the domestic policy and decisions, are treated here as a external element, as the "energy system" does not have a direct control on the issue.

The population of OECD countries is estimated to grow on average by 0.3% over year until 2020. It is assumed that there will be less population growth in developing countries (1.3% per year) than the last three decades (2%). The world population is assumed to be growing to 7.4 billion in 2020 from 6 billion today, with 81% population living in developing countries (IEA, 2000). Overall, the population growth will be a severe constraint to the global resource allocation: It poses a challenge in terms of supplying energy to those populations.

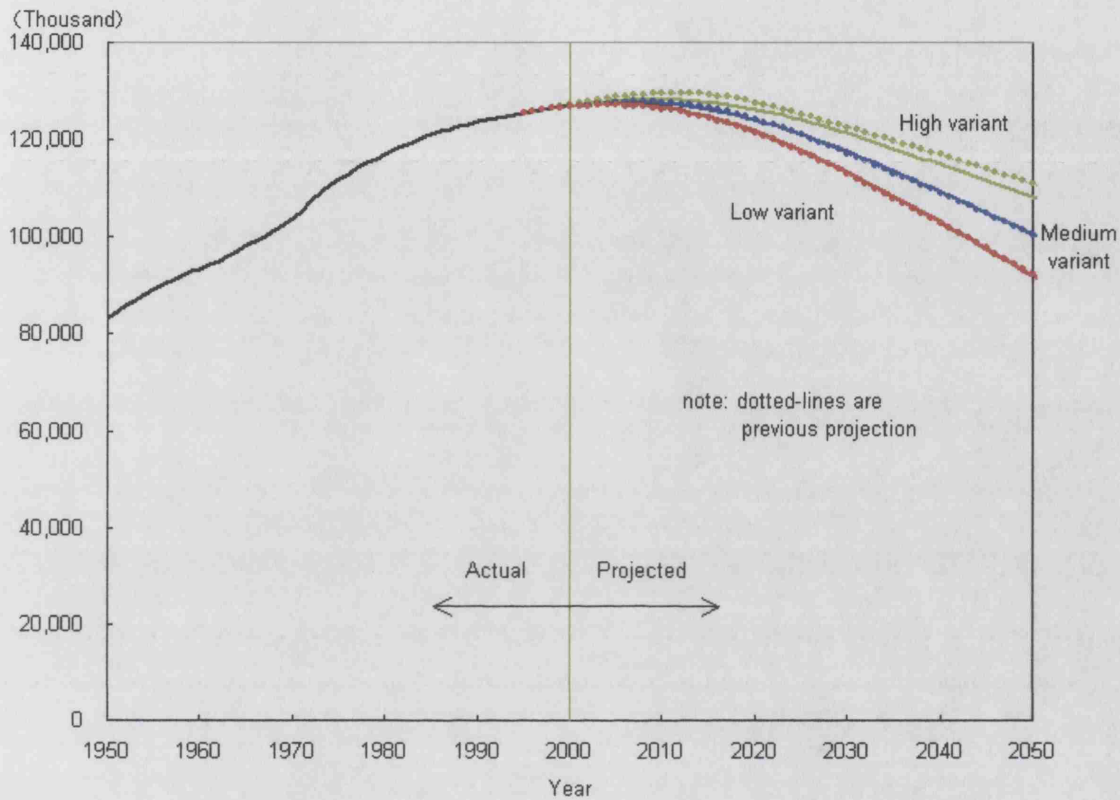
Population in Japan is predicted to be growing until the first decade of the 21st century, then will be reduced. The research takes the officially predicted population fluctuation, and assumes there is no drastic change to the estimate.

Household numbers are predicted to increase, whereas the size of household is reduced. The household demography ultimately has an implication for energy

consumption of the sector, and will be considered as part of a strategic element relevant to the lifestyle change discussion.

Another demographic feature related to the energy system is the ageing of the society. The social costs borne by the younger generation may discourage their economic activity, consequently reduce the energy demand. Also, the population in Japan is estimated to mark a decline by 2030 (Figure 4.10). This will result in fewer workforces, which likely to reduce economic and production activities, as well as the energy demand. On the other hand, energy consumption per person may increase, as people use more energy through, e.g. electric services for air conditioning and heating, transport by passenger cars, etc., which may offset the effect of population decrease.

Figure 4. 10: Japanese population estimated



(Source: National Institute of Population and Social Security Research, 2002)

4.3.4 International Emission Trading

There is an ongoing debate as to whether the international emission trading should be recognised as a GHGs reduction measure. The issue, together with the controversy over how to count GHGs sinks, was heavily discussed in the 6th Conference for Participants for the UNFCCC in The Hague, the Netherlands in

November 2000.

There are some countries where domestic emission trading is getting introduced. The UK Emissions Trading Scheme (ETS) was started in April 2002 with 34 participants, in which the companies are able to use the scheme to buy and sell allowances (DEFRA, homepage). In 2003, the Japanese government launched a trial scheme to test feasibility of the trading. About 30 companies have participated to the scheme and the finding through their experience was published (MOE, 2003). As well as these domestic developments, international emission trading is due to start 2008 to 2012.

Although the international emission trading will have a significant implication to the climate policy strategy, this research takes the position that emissions have to be reduced primarily through a country's own activities. The main focus of the research, therefore, is on the energy-related GHGs and the degree and kinds of their domestic abatement.

4.4 Contextual Element: Strong and Weak Sustainability

On the contrary to the external elements, the contextual and strategic elements are

supposed to have intensive interactions with a society's energy system. This study takes the degree of sustainability as the contextual element.

There is a wide range of definitions of sustainability and sustainable development. One of the most widely supported representations of sustainable development is by the Bruntland Commission as:

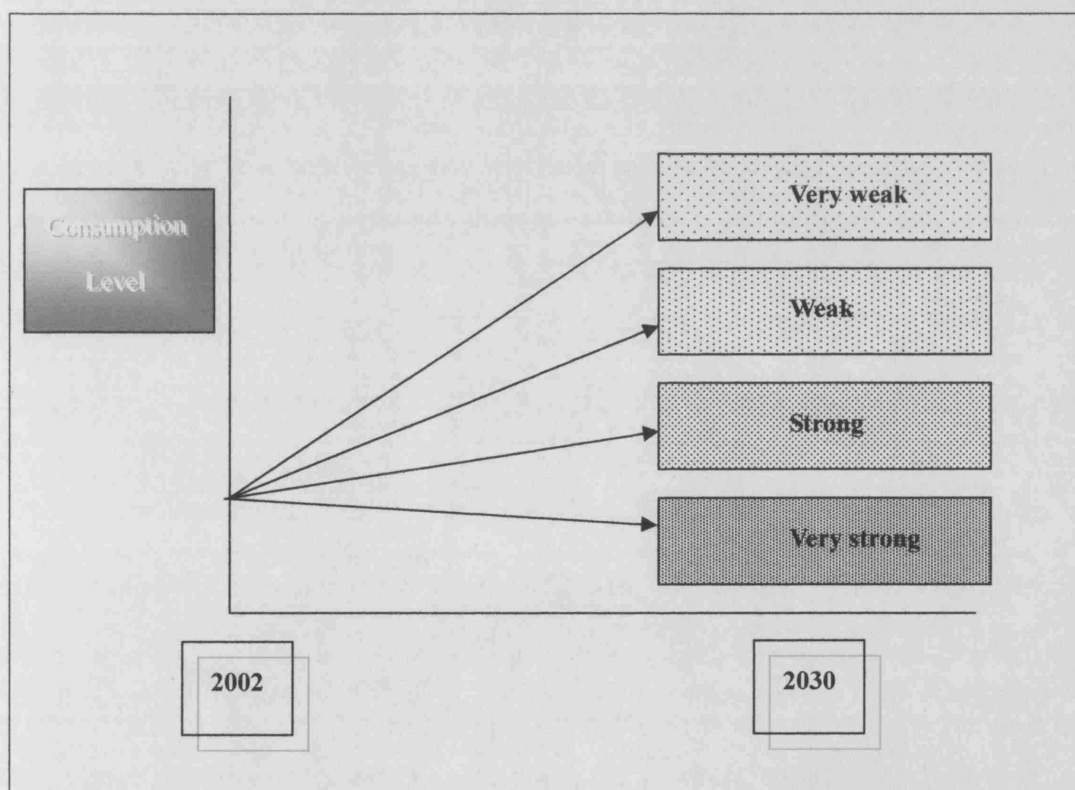
Humanity has the ability to make development sustainable - to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. (WCED, 1987)

Though often regarded as the "definition" of Sustainability, this statement, in fact, merely describes the outcome of the sustainability where successful intergenerational resource transfer takes place. It is not clear what it means to the current practical aspects of human life, such as its energy use. In other words, it is necessary to elaborate the implication of "sustainability" and its relation to energy debates, so that the way to achieve it could be constructed.

Sustainability has been classified into a range of categories, depending on the different views toward resources. For example, Turner identifies four different

degrees of sustainability from "very weak sustainability" to "very strong sustainability" (Turner, 1993). Some of the key concepts in the Turner's argument, such as inter-resource substitution, issue of de-coupling and the limitation of thermal input, provide a useful index for the Japan's sustainable energy future. They will, therefore, be described in the following sections.

Figure 4. 11 Strong and weak sustainability



4.4.1 Very Weak Sustainability Approach (VWS)

In the Very Weak Sustainability approach (VWS), which only requires maintenance of constant capital assets, economic growth and, subsequently, energy consumption and resource depletion are both justified, as long as the man-made capital is increased.

The very weak sustainability approach has much common with environmental economics which sees that nature as a part of economy, and is substitutable by the other factors of production. This position is well represented by Beckerman, who argues that the purpose of increased income level is the optimisation of overall welfare which covers the area of social capital availability, increased health care and life expectancy, etc. (Beckerman, 2002). The underlying view on this approach is “optimism” to assume earth’s carrying capacity is still sufficient to support the scale of human economy (that enables the continuing increase of our welfare level). In this position, value of the nature is measured only against utilities to human welfare.

For the continuation of the VWS position, significant change from the current energy situation would not be required. The target for the Vision I of this research

is established along the line with the VWS approach, requiring the modest change relative to the current circumstances.

4.4.2 Weak Sustainability Approach (WS)

There are strong criticisms over the VWS position. Many of the criticisms are related with its optimism over the inter-exchangeability of natural and man-made resources. Based on the reflection that complete inter-resources substitution is not feasible and even damaging to the long-term sustainability of the environment, the concept of safe minimum standards (SMS) is introduced in the Weak Sustainability (WS) approach to safeguard the minimum resources necessary for the ecosystem maintenance.

The WS approach requires some level of constraints on resource consumption and economic activities to avoid irreversible result. The managerial position, however, is still dominant in this approach. In other words, in this approach, natural stocks are carrying instrumental value in resource conservation. This approach is broadly reflected into the Vision II, on which strong emphasis is given to managerial solution through inter-fossil fuels switch, especially from petroleum and coal to natural gas use in power plants.

4.4.3 Strong Sustainability Approach (SS)

The Strong Sustainability (SS) approach starts with the doubt over the WS approach: It differs from the WS as it stands the point that the successful identification of safeguard values for critical resources is impossible. The SS approach demands steady state economy where the maintenance of ecological system as a whole is ensured.

Decoupling between the economy and the resource use should be possible through technical change and environmental investment. This position would correspond with the expectation in industrialised countries that energy demand level would be reduced, as well as environmentally benign form of energy sources being developed through technological advancement. The strong sustainability approach is reflected into the Vision III of this research, whose primary concern is on the heavy push on renewable energy technology.

Another issue relates to this Vision is that it allows the scale of economy can be maintained. Whether the maintenance of economic scale and the long-term GHGs emission reduction can go parallel is a matter of argument, as the Very Strong

Sustainability argues as follows, the macro-economy size might have overgrown the carrying capacity for human beings.

4.4.4 Very Strong Sustainability Approach (VSS)

Very Strong Sustainability approach is based on the rethinking over the relationship between natural and human metabolism systems. Daly, who is strongly associated with the VSS position, sees the economy as a sub-order of the ecological system. He claims that economy is ultimately depending on the stocks created by the nature.

The total economic process is itself a sub-process on the consuming side of the total ecological life process, the producing side of the latter consisting mainly of photosynthesis carried on by green plants, which draw their inputs from the physical environment of air, soil, water and sunlight. (Daly, 1993)

In a very real sense the entire physical environment is capital, since it is only through the agency of air, soil, and water that plant life is able to capture the solar energy upon which the whole hierarchy of life (and value) depends. (Ibid.)

As the entire size of the earth's ecological system is determined by the productivity of the primary producers, the capacity idea is brought into the context of economic activities. The VSS approach requires the economic scale should be decreased, as it considers the global economy has overgrown its supporting capacity. It also identifies the global warming as the result of entropy expansion. Too much inaccessible or low-grade energy exists in the earth's atmosphere to such an extent that the primary producers can not convert it into low-entropy status. The message of the approach is clear: Energy input to the ecosystem must be limited, if the climate change is to be reduced, or, at least, moderated.

Here, again the technological support would help restrict such an energy input, as is the case of the SS approach. The difference between the VSS and SS approaches is that the VSS approach deems that the global warming phenomena as a result of an excessive macro-economy size. Therefore, its capacity constraint is regarded as imperative: Much greater energy demand reduction is required than that in the SS approach.

4.5 Strategic Elements

A number of factors will have implications to an energy systems. Strategic

elements are those which provide sufficient "tools" to produce environmental change of an energy system. There are four major strategic elements identified.

4.5.1 Economy

The research's objective is to explore the means to de-couple the links between economic growth and environmental impacts. De-coupling is a situation where environmental degradation reduces regardless of the increased income⁹. It is often argued the de-coupling is not a natural course, but a process in which political action is imperative (Azar, et. al, 2002).

This argument applies to Japan, which has been much discussed as an example of successful de-coupling, at least in the following years of oil crisis (1960s-1970s). During the later years, especially in 1990s, it saw the synchronised growth of national income and CO2 emission volumes. This illustrates the difficulty of de-coupling, when necessary policy actions are absent.

⁹ There are further definitions about the types of decoupling. *Absolute decoupling* means the combination of economic growth with reduction of emissions, whereas *relative decoupling* is economic growth rate is higher than the growth rate of energy use or CO2 emissions (Minnesma, 2003). In this research decoupling signifies the absolute decoupling.

The purpose of the research is to identify the required policies to abate the environmental adversity, mainly caused by CO₂ emissions. Therefore, it does not take a conventional approach to establish a certain economic target to be achieved and to link it with the energy supply-demand structure.

4.5.2 Inter-resource change

Strategic decision on how to allocate different type of energy sources greatly influences the level of pollution. The renewable energy sources, for example, often produce less CO₂ and other pollutants, and the deployment of those sources is expected to have an environmental advantage. Inter-resources change, even between non-renewable energy sources, significantly affects the degree of pollution and contamination.

Forms of available energy will also have a vital implication to the domestic and commercial sector's energy requirement. For example, as have been reviewed in the Chapter 2, electricity share of the final energy requirement is currently about 17%. On the other hand, the purposes for which electricity is indispensable are estimated as 12% of the total final energy consumption in Japan (Lovins, 1981). The gap between the least requirement for electricity and actual electricity supply

has been increasingly widening as the electrification rate is growing.

Electricity is, however, physically and financially expensive form of energy, with significant amount of other forms of energy is required, and often wasted, during its production and delivery. To use electricity for the inappropriate purposes, typically heating buildings, is recognised as a waste of the primary energy (*ibid.*). Systems which minimise wasted energy, such as combined heat and power and its affiliation with district energy supply system, would be of particular significance to the residential and commercial sectors' energy management.

4.5.3 Technology

Energy technology is constantly making progresses and the precise prediction as to which technology is to be developed, or when the technology is available, is highly difficult. More importantly, technological advancement is strongly influenced by the strategic decisions that make the technology available to a society. The research, therefore, attempts to present different Visions, not for the pure technological prediction purpose, but for identification of those measures that support their development.

4.5.4 Lifestyle Change

Life style change has been often highlighted in Japan, especially in the context of demand management. The importance of individual effort, which could be rather trivial, is often over-emphasised. There is no denial that people should be encouraged to reduce their energy consumption. Strategic thinking, however, is also required in the residential sector's energy management. For example, for the transport sector, the degree of mobility sought by people will determine the aggregate transport fuel requirement. Therefore, availability of infrastructure and land use planning, rather than mere encouragement on people for walking, have strong implication on people's travel patterns.

At the same time, other areas, such as politics and industrial structure, also should be covered under the heading of “lifestyle change”: Political will and its decisions could determine the size and types of the economy, which would subsequently influence the whole domestic energy structure. It also sets the structure of energy market and the energy prices. Experience has shown that the power balance between central and local politics often plays a significant role in the development of less-explored energy sources, and their distribution. For example, it has been reported that experimental initiatives are actively developed in Germany, where

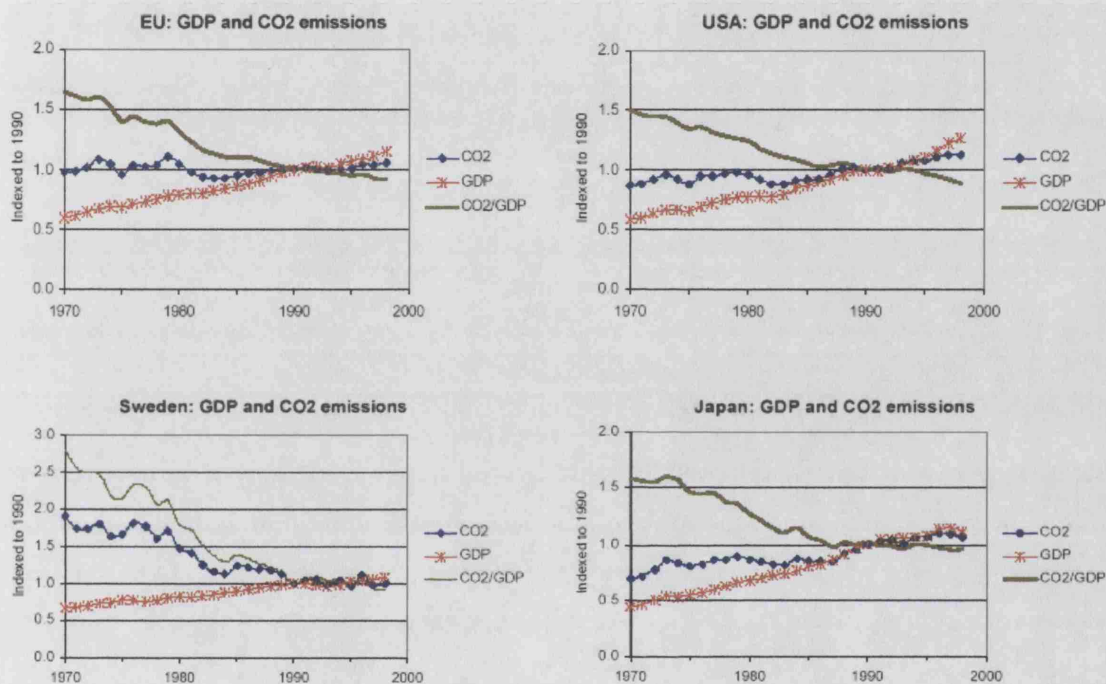
local Länders have its own right to decide their energy policies (Jochem, 1996).

Thus, energy demand is ultimately an aggregate of the factors associated with issues such as demography, economy, and politics. It is also a strategic element, with each sector's demand can be controlled to achieve overall pollution reduction. Analysis on the types of required energy has a significant importance to the energy demand management. As has been discussed in Chapter 3, there has not been sufficient study in Japan to identify energy requirement in different energy forms such as electricity, heat and transport propulsion. This creates a situation where electricity demand grows gradually over decades (as illustrated in the Table 2.5 in Chapter 2). The identification of energy requirement for different types, followed by appropriate demand management, could have a significant implication to the overall energy demand reduction.

4.6 Structural Change

Structural change demands a particular care for its treatment. The history has shown a pattern of industrialisation and its associated energy use: As in the Figure 4.7, for the industrialised countries, CO₂ intensity decreases as the material and energy efficiency improves (Azar, et. al, 2002).

Figure 4. 12: GDP and carbon emissions in the EU, Sweden, the US and Japan
(indexed to 1990)



(Source: Azar, et. al., 2002)

The improvement of efficiency, however, is not the only reason for the energy intensity reduction: Structural adjustment is another factor contributing to this phenomenon as the industrialised countries move their business and manufacturing bases to foreign domains in search of cheaper supply of labour. It is the same case in Japan where a significant proportion of material and energy

consumption is exported outside of a national boundary¹⁰.

Globalisation is a circumstance under which industrial shifts are accelerated, encouraged by reduced trade barriers between the players and by the imposition of the "global" business standard. As the globalisation connects physically remote areas in the world, potentially domestic metabolisms, such as supply of material and energy, as well as disposal and discharge of the unwanted material and energy, are also carried out in the distant places.

The argument about the remote metabolism leads to the debate of the "ecological footprint", which suggests the real size of an economy can be significantly larger than a nation's economic size measured in the financial account, (such as GNP). As a result of the ecological "big-foot", an enormous strain may be posed to the remote hinterlands which support the main economy (Wackernagel, 1996). This could bring anomalies such as the most of the resources in the hinterland are used to satisfy demand for a larger economy, even the same resources could have been supplying the basic requirements to its own population.

¹⁰ Conventional national energy statistics may fall short of accounting the energy required outside of a country's boundary. This situation may increase the demand for a novel framework to account energy requirement which is necessary for a country's economic growth, but taking place globally.

The question on how much is the "hidden" metabolism exists, and, more importantly, how much the size of a footprint should be reduced, became the core argument of ecological footprint debate. Encouragement of regional self-sufficiency, both in terms of material and energy supply-demand, has been the centre of attention as a key to the human sustainable future (*ibid.*).

4.7 Visions of the Sustainable Future 2030

The conceptualisation review in above sections provided an analytical framework for exploring different sustainability approaches. This section focuses on the creation of four Visions, paying particular attention to the key concepts suggested by the combination of different approaches.

The four Visions will have distinct priorities for change and implications to the society, but these priorities are not mutually exclusive. It is the balance of decision that determines which priority for change gains dominance over others. By keeping these elements mutually shared, the indicative nature of the Visions is maintained. It will be thus possible to avoid unnecessary rigidity upon application of the Visions to the real policy context.

4.7.1 Vision I: Business as Usual (the “BAU”)

4.7.1.1 Vision Outline

This is the Vision which assumes that the current political, economic and other conditions are continued without any significant change. It follows the Japanese government's presumption for the economic growth and energy supply-demand structure, in which the government sees the energy supply is directly connected with the economic growth.

The Japanese government's energy policy has been traditionally based on the aspiration to further economic growth, and energy supply-demand structure is seen as an instrumental to the economic expansion. Cheaper energy supply to industry and the other sector dominates the government priority. The fuel diversification programme is driven by the security of energy, rather than sustainability argument. Nuclear and other large-scale thermal power production remain intact.

In the government Forecast, the discussions for energy quality and energy carrier

are largely absent. The government forecast also places less importance on the demand-side analysis. The de-coupling possibility, therefore, will be severely restricted in this Vision, though the demand-side energy management is, to a limited extent, encouraged and they will be carried out through technological means and people's individual efforts. However, the larger size of demand management which needs drastic re-thinking of energy delivery structure receives no serious consideration.

The energy market re-organisation has a mixed effects. The wave of privatisation, which was initiated in the late 1990s, inevitably had a big influence over the Japanese energy market. Large electricity consumers have been able to choose their suppliers, and the grid is gradually open to a certain power producers.

The further progress of the trend, however, is not necessarily on the government agenda. Arrangement prerequisite for further liberalisation, such as the free access to the power grid, is yet to be materialised. The market re-organisation also lacks the environmental perspective and, as a result, the number of thermal power stations using fossil fuels will increase. Overall, the major electricity companies will maintain the monopolistic power in their supply areas.

The progress of demand-side management and renewable energy development is hindered both by lack of political will and by fragmentation of policy actions. Local government's initiatives in the energy development and its distribution remain marginal. The emergence of gas and renewable energy as energy sources face obstacles under the "arm's length approach" of the government towards the utilities to conserve the "status-quo".

The aggressive financial incentives contribute to persuading local governments to accept some additional power sites. Nuclear development, however, does not go forward to the extent that the government expects, as a result of a gradually staled energy demand and increasingly fierce local oppositions.

4.7.1.2 Implications of the Vision

The implication of the BAU Vision to the industry is significant. The industry demands cheap energy supply for their competitiveness, and they will certainly derive benefit from the government policy: the cheap energy supply could keep the heavy industry operated within the Japanese domain, which would have otherwise shifted to foreign locations.

Brownouts and blackouts could, however, potentially increase, causing disruptions to industry, as the infrastructure becomes old and deteriorates. The government and industry will be further devoted to keep secure financial resources earmarked to upgrade energy supply infrastructure. The budget can be financed through tax. Serious protest against tax increase may happen, even though the Japanese taxpayers are relatively quiet on such a tax increase. As a result, easy financing for big energy projects may be hindered.

Domestic and commercial sectors remain as energy consumers, hence, they are the main sources of income to utilities. Although there are some measures to encourage those sectors to be energy-efficient, those measures remain ineffective: the more they consume, the more the government and the utilities can earn. So, why discourage their consumption?

The same picture applies to the transport sector where traffic demand management faces of dilemma with the government policy on economic growth. The level of mobility will be further stimulated by the continuous investment on road construction. Public transport is gradually seen as obsolete, and its share in the whole transport modes decreases. World trade is encouraged, with increased food imports. Overall, the government investment on surface and air transportation

maintains its position as a means to stimulate economic vitality.

4.7.2 Vision II: Japan as an Energy Importer (the “Gas Japan”)

4.7.2.1 Vision Outline

This Vision is based on a prediction that Japan will be relying on substitutional resources to avoid particular emissions, such as GHGs. One of the most practical scenarios for Japan to meet its Kyoto Protocol obligation is to increase its dependence on gas as the main energy source, with the background of its relative abundance and its less CO₂ emission potentiality.

Care is still required to distinguish two very different courses of action associated with gas utilisation. One is the use of gas as a substitute for other conventional fuels, such as oil and coal in the existing thermal power stations. The second course is to use gas in micro-turbines to generate electricity and heat supplied to the adjacent vicinity nearby the turbine instalment.

The later case (the gas use in micro-turbines) requires very different socio-technical structure to operate in, compared to the gas use in thermal power

station. For example, it demands fundamental change to the people's attitude to generation of electricity.

In the "gas in thermal power station" case, the gas imported will be used mainly for the production of electricity. There would be some deployment of combined cycle gas and turbine (CCGT). The danger of the "gas in thermal power station" case is that the emphasis is strongly on the supply side, with little importance is placed on the demand side management.

Under this case, there would not be significant reconsideration on further electrification and "energy quality" debates. The environmental quality of the gas, therefore, is offset by the electricity demand. This Vision would probably face a conflict with the increasingly strong international recognition that natural gas is too valuable to be used for low-grade (heat) purposes. Also, the "dash" towards the gas use probably delays the extensive development of renewable energy sources, such as solar and wind. Also, with the background that electricity demand is not reduced, the emphasis currently attached to the role of nuclear in the energy supply structure remains largely intact.

The pipeline connecting Japan and international gas fields will be constructed

with a large scale national and international financial involvement. It is, in fact, reported that extensive gas pipeline construction projects will be initiated in the first decade of 21st century, covering Russian and Indonesian terrains. These projects need careful examination in terms of financial and environmental cost, as well as risks of earthquake and of becoming the target for terrorism. On the other hand, the costs for the current LNG imports will be reduced: at least the switching from LNG to direct gas import through the pipeline would contribute to lessening on-site gas use and the associated emissions at the foreign gas fields.

The price of the imported gas will be maintained as competitive, with the strong financial support from the government: for example, the government subsidises most of the required financial resources for infrastructure construction, such as international gas pipeline. Construction of the pipeline will be strongly connected with the overseas assistance budget and the international financial arrangements, such as the Kyoto mechanism. The overseas assistance, which is increasingly receiving criticisms for its ineffectiveness, finds the way to survive as a mean to contribute to the Japan's GHG reduction¹¹.

¹¹ There are growing amount of criticism to accuse the way the Japanese development aid is organised and managed. For example, the Sakhalin II Project in Russia is to develop oil and natural gas reserves of which main potential customers are Japan and Korea. The project is funded by Export-Import Bank of Japan, Overseas Private Investment Corporation and European Bank for Reconstruction and Development. Critics argue the project could be harmful to fisheries and

Gas is, however, still one of the fossil fuels with its availability finite. Thus, "Gas Japan" future exposes its limitation. Nevertheless, it is important to assess the sustainability of the approach and "Gas Japan" future, especially as an intermediate solution. This research sets 2030 as its focal analytical end point, therefore, the intermediate concern gains a particular weight.

4.7.2.2 Implications of the Vision

Industry keeps its structure as the conventional energy supply level can be maintained by the massive gas imports. The energy market re-organisation will be carried out in a way that supply side competition will be ensured, but to a limited extent. Major international energy companies are already developing natural gas route entailing pipeline in Sakhalin, through which gas would be imported to Japan¹². The Tokyo Electric Company and the Tokyo Gas Co., Ltd. made a contract to purchase the gas imported with the Sakhalin II pipeline project in May 2003. If gas is given a priority in the overall energy policy under the Vision II, big

ecosystems in the Sea of Okhotsk. Further information is available at: <http://www.foejapan.org/>

¹² Exxon, together with Itochu and Marubeni, is planning a project called "Sakhalin I", which directly connects a pipeline in Sakhalin to Japan. The Sakhalin II project is to develop a pipeline in Sakhalin and ship liquidised natural gas to Japan.

gas consumers, typically the Tokyo Electricity, may increase the reliance on imported natural gas for power generation.

Commercial and domestic sectors continue to be energy consumers, rather than producers. There is not much difference for the people's life, with their dependency on electricity increases. The investment for domestic gas distribution systems may not match with that for the international pipeline. Most of the gas will be converted into the form of electricity, rather than be used as heat. Co-generation possibility is largely ignored, mainly because energy quality discussion is absent.

In this approach, much effort is placed on preserving oil, as it is regarded as scarce. Therefore, though the level of mobility is maintained, some degree of demand management is placed for oil-dependent transport. On the other hand, the resources assumed to be more abundant (such as LPG and LNG) will be exploited for transport purposes. Also, the ownership of electric car, as well as that of hybrid car, increases as the technology widely available. Public transport is undervalued, and it is not seen as a main solution to increased demand for mobility. The value of self-energised form of transport, such as bicycle, is also underestimated against hetero-energised transport means, typically cars.

4.7.3 Vision III: Push for Big Green Energy (the “Renewable Emergence”)

4.7.3.1 Vision Outline

This Vision is based on the assumption that the energy quality argument gains wider audiences, though the extent to which significance is attached to it is still limited. Also, a wide range of renewable energy sources is developed in a large scale.

Under this Vision, the de-coupling between economic growth and resource conservation wins its strong position in the entire national energy strategy. A large amount of financial resources are invested into renewable energy and its related infrastructure through a wide range of mechanisms. For example, the voluntary tendering scheme at least stimulates some renewable energy development, especially for wind power. The investment to those renewable energies is made with the premise that they are ultimately to replace the nuclear share in the energy supply structure. Together with energy demand management, which is to some extent available in the Vision III, they contribute to the reduction of nuclear deployment.

The expectation for technology as a *deus ex machina* solution, however, has its dangers if it goes extreme, notably in the situation where a comparatively disproportionate attention is given to renewable energy: industry even considers importing renewable energy from foreign countries, where renewable energy is plentiful. In that case, industry finances its necessary investment from additional charges to consumers. If that happens, the cost implications of this assumption can be very expensive.

4.7.3.2 Implications of the Vision

The industrial sector will gradually start to use renewable energy. As a result, the renewable energy production thrives. The demand for green electricity is, however, limited among the big companies, as the tendering schemes, which is to ensure the cheapest bidder win the contract, stimulates the market, but not to the extent that smaller companies will be attracted to green energy. Because of the uncertainty as to the bidding price and return-on-investment, the bidders are limited to those who can finance large investment capital themselves.

To some extent, the domestic/commercial sector becomes the energy producer, as

well as consumer. The market is re-organised in the way which smaller-scale player's entrance is liberalised. The focus of interest is, however, on the large-scale renewable energy development: as a result, domestic and commercial sectors' power production potential does not gain its highest momentum.

Mobility demand is high, but with the help of technology, fuel demand is significantly lower than the benchmark level. On the other hand, technical solutions, e.g. fuel cells car, become popular although they do not necessarily remove the fundamental problems, such as congestion and risks of road accident.

This Vision presupposes the scale of economy to be maintained. Therefore, although there would be reduction of energy demand and its associated emissions, the reduction could be offset by the entire economic growth. The Vision also lacks the large-scale energy demand management, which could potentially reduce the entire need for renewable energy development itself. The cost implications of this Vision need serious consideration, as the technology pushes it upward.

4.7.4 Vision IV: Thermal Input Limitation and Dawn of Micro Energies (the “Ecological Footprint”)

4.7.4.1 Vision Outline

The Vision IV is based on the recognition that the climate change as the result of failure on thermodynamic management. The underlying position of the Vision is that the global warming will exasperate unless energy input to the biosphere is limited.

The Vision IV shares some elements with the Visions II and III, but is based on the conviction that the global imperatives require more drastic changes to reduce energy consumption. Also, the Vision proposes de-fossilisation of energy sources and decentralisation of energy production. In this Vision, on-site use of gas, renewable energy sources and fuel cells become widely available. Industries, household and commercial sectors are all given access to the electricity grid: it is up to their decision whether they buy or sell electricity to and from utilities.

Also, in the Vision IV, the energy quality argument becomes the focal point of discussion. The Vision sees the constraint on further electrification as an

imperative. Combined heat and power (CHP) is widely adopted by residential and industrial sectors to increase the efficiency.

The necessity to reduce economic size gains the wider support. Various measures are taken for demand management. The stricter regulatory control is prepared for transport sector, as well as for domestic/commercial sector. Energy demand management will also be encouraged for the industry sector. The energy demand reduction contributes to reduce the energy supply as a whole.

4.7.4.2 Implications of the Vision

Consumers are regarded as producers of energy. The energy they self-produce is consumed at their own dwellings or within their communities. The excess energy is sold to electricity companies. The self-production of energy and its connection to the market generally enhances the people's awareness towards energy issues. As a result, energy saving lifestyle is gradually adopted.

The ownership of energy sources varies according to the optimal size. There are many domestic and commercial buildings with solar equipment. Wind power is owned by local communities, under municipal government initiative and/or

private co-operative ownership. Given the fact that installed wind power capacity has overgrown the estimate¹³, their continuous expansion through a various policy actions is promising.

Demand for the mobility is reduced, as a result of integrated approaches between planning and transport. Financial and other resources for road construction are diverted to public transport. Also, agriculture policy is transformed to provide biomass fuel for transport propulsion.

Oil consumption is restricted. Chemical industry is to some extent forced to divert its business direction, as a result of decrease in demand for materials, such as plastic. Some utilities, which are dependent on conventional large-scale power generation facilities, will suffer a serious business backlash as the privatisation of the market proceeds, and energy demand of a society decreases. Some of the utilities with better preparedness will find new business niches, such as supply of micro-energy equipment and energy consulting.

The cost of the Vision IV is mainly financed by the diversion of existing financial

¹³ Over 100 MW capacity is predicted to be available by the end of 2005 (Tronc 2003). This number well exceeded the government estimation that only 30 MW capacity will be available by 2010.

resources into new orientations. The whole economic structure is re-shaped, by abandoning the protectionist approach. In other words, the government intervention maintains its significance, but not in a sense that it provides opportunity for a limited sector of industry, but that it provides necessary guidance and strategy for the entire society.

4.8 Concluding Remarks

This chapter described key features for methodological framework. It also introduced contextual and strategic elements, and how they combined to form alternative visions of futures.

Four different Visions of alternative futures were illustrated. Also, numerical targets were linked with the Visions to give more clear sense to the scenario assumptions. The four Visions of the future is the starting point for the formulation of policy packages, which are discussed in the following chapter.

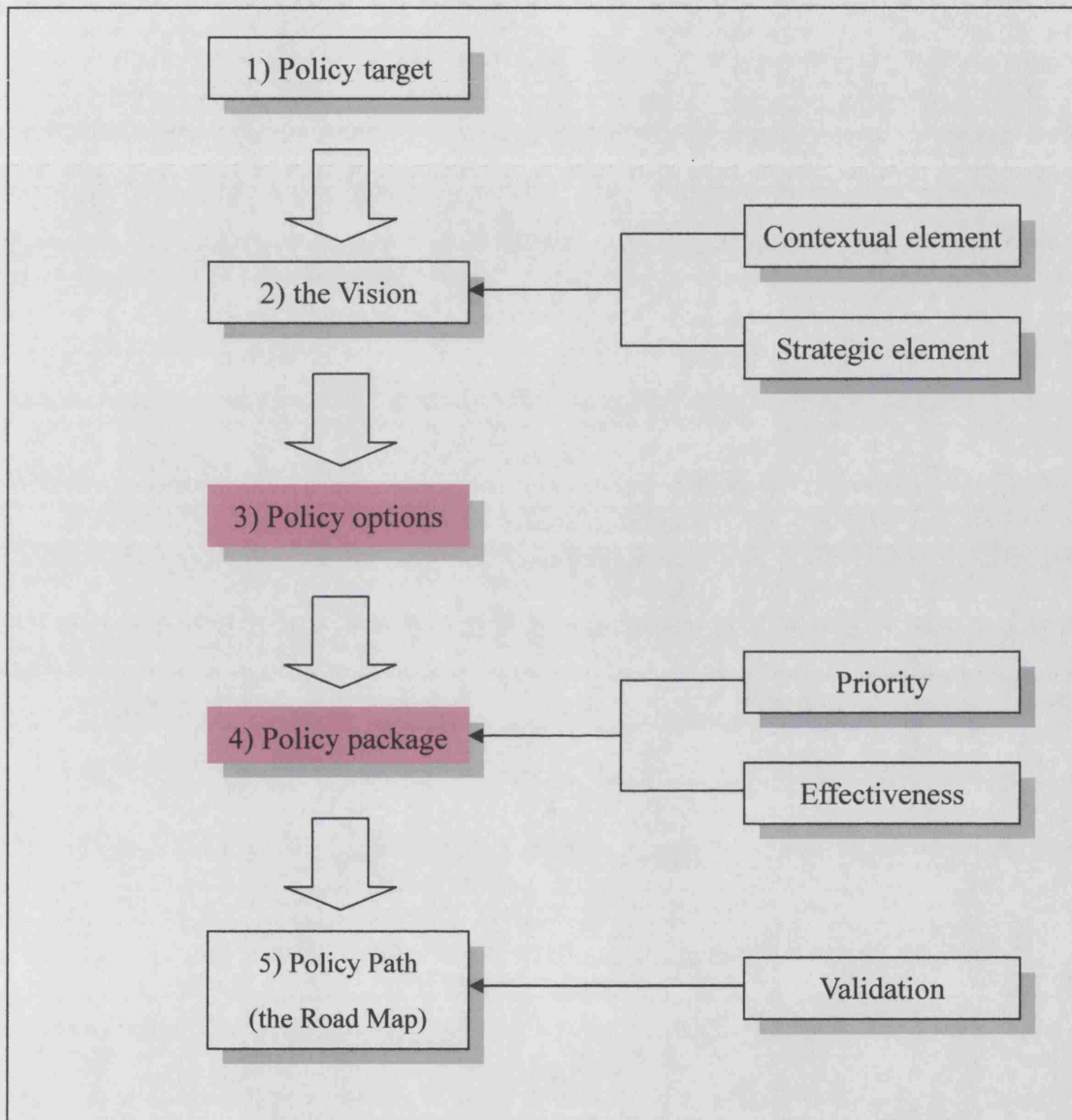
Chapter 5: INPUTS FROM EXPERTS

5.1 Introduction

This chapter and the next chapter illustrate the policy options, packages and paths for achieving the Visions. The Chapter 5 describes the policy options in packages (the third and forth stages of the Figure 5.1), whereas in the Chapter 6, these options are laid down to constitute policy paths (the fifth stage of the Figure 5.1).

This chapter first describes the role of policy options, package and policy paths, and the methodology to assemble them. It introduces the first round questionnaire survey of which purpose is to obtain experts' views on 1) policy option priority and 2) policy option effectiveness. Finally, it establishes the policy packages corresponding to the 4 Visions.

Figure 5. 1: Flow of the study (after Figure 4.1)



5.1.1 Validation Process

There are a wide range of policy measures (the “policy option” in this study) potentially available to achieve desirable effects. The policy options are categorised under several policy orientations, e.g. supply, demand, infrastructure and market strategies, etc.

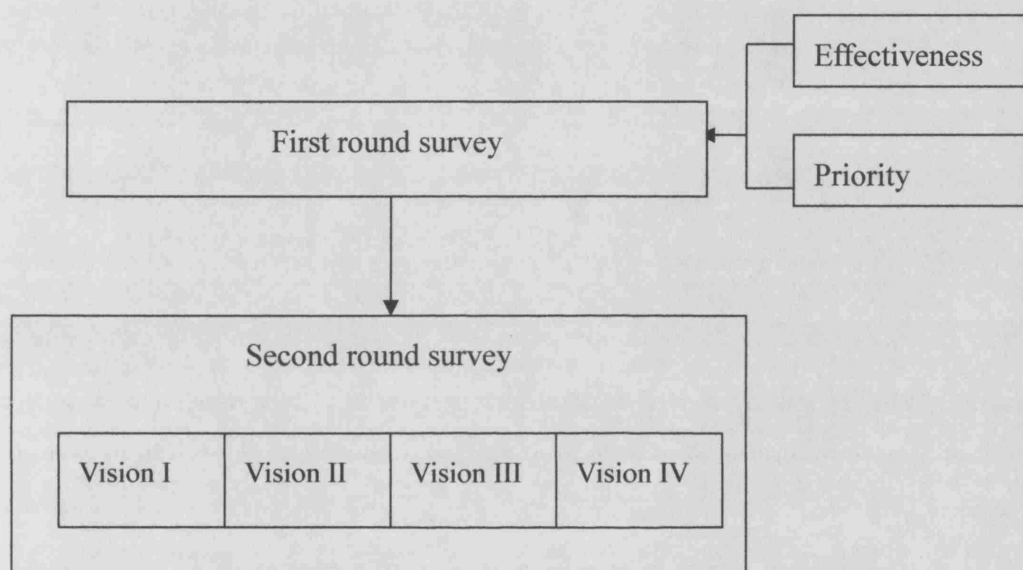
The policy paths in this study are defined as “the combination of policy options as a package, which presents a clear flow of steps to be taken to reach a particular future Vision”. The timing of introducing policy options and the strength of their implementation also have to be identified, so that synergies among the policy options can be maximised.

A variety of energy experts are invited to the policy paths construction processes. The backcasting methodology requires qualitative judgement on the desired future Visions, and involvement of multiple experts is designed to give an assessment on the consistency between the future Visions and the paths leading to them.

In the first round questionnaire, experts’ validation process was used as a means to evaluate the value and positioning of policy measures, whereas in the second

round validation process, the assembled policy paths (the road map) were assessed mainly in terms of its appropriateness as a coherent policy package (Figure 5.2).

Table 5. 1: Survey structure



5.1.2 Selection of the Experts

The important aspect of the validation process is that the process itself is already “a part of the dissemination strategy of the project results” (Banister, et. al., 2000).

It serves as a means to interact with the key figures in the energy policy field, who could have influences on the real policy formulation process. Particular attention was therefore paid to contact those who are active and open to strategic policy

making. Also, a great care has been taken to have a wide spectrum of backgrounds, so that their inputs can be instrumental in clarifying alternatives and priorities.

In the First Round Survey, 11 experts have responded. This includes 1 with government, 3 with industrial, 3 with consultant/research, 2 with academics, 2 with environmental organisation background. Appendix D provides the name of the experts and their backgrounds. Although the number of experts is rather limited, the professional credibility represented by them would ensure a fair and balanced evaluation of the options.

5.1.3 Evaluation Methodology

Policy options (measures) should be organised to create policy paths which are systematically ordered to make steps to the defined Images of the Future. To organise the various policy options, in a strategic scheme, the concept of priority and effectiveness are introduced.

The options with high priority is defined here as those that should be implemented immediately. The guiding principle of “priority” is in line with those recognised by the POSSUM consortium (Banister, et. al., 2000) as:

- 1) Principle of acceptability: the measure should not be too controversial today
- 2) Principle of inertia or long lead-times: measures that are essential to goal fulfilment but will have a delayed effect should be implemented early
- 3) Principle of dynamic effect: measures that will set dynamic processes in motion should be implemented early
- 4) Principle of adaptability: measures that tend to retain freedom of action in the future are often to be preferred to measures leading to lock-in solutions

On the other hand, guiding principles for effectiveness is decided by a principle of immediate result: in this study, an assumption is made that options which would contribute to immediate pollution reduction has high effectiveness.

Experts were asked to give higher priority score if the option requires urgent implementation (even if the effectiveness of the option itself may be limited). For example, the political decentralisation may have little effect itself on the reduction of CO₂ emission, but it could be a crucial step to enable wider adoption of sustainable energy use. Thus the priority of the local empowerment option may get high score.

The experts were requested to mark the options according to three scales of rating (A, B and C), for both priority and effectiveness perspectives. The rating of the options were later converted to numerical count (A=3, B=2 and C=1) and summed as the overall scorings¹. The three scorings were created as:

- 1) the overall score to reflect the sum of priority and effective scores
- 2) the priority score
- 3) the effectiveness score

For the formulation of policy packages, the priority and effectiveness scores were cross-checked in order to identify the structural position of the options, which can be described as in the Table 5.2.

Table 5. 2: Priority and effectiveness scores

	Score			
	Column 1	Column 2	Column 3	Column 4
Priority	High	High	Low	Low
Effectiveness	High	Low	High	Low

¹ For the effectiveness evaluation, there are also D and E ratings. D is for the experts wish to reserve their opinions, and counted as 0. The experts were requested to specify their reservations when they choose D. E is when the experts consider the option has a negative effect to achieve the Visions, and counted as -2.

If the priority score for a particular option is low, and the effectiveness score is also low, the option can be considered as insignificant as a policy (Column 4). On the other hand, if its effectiveness score is high, the option may be significant, but the experts see the option should be implemented at a later stage (Column 3). Conversely, a situation can be conceived that the priority score for the option is high, even though the effectiveness score is low (Column 2). In this case, its early adoption is required not just from the effectiveness point of view, but from a variety of other perspectives.

5.1.4 Policy Option Assessment

A questionnaire survey has been carried out from 1 February to 31 April 2001.

The survey includes the following steps:

- 1) The first stage: to have an initial discussion with core experts to establish the overall targets for the Vision 2030:
- 2) The second stage: to set up policy packages to achieve the Visions described in Chapter 4:
- 3) The third stage: to conduct a questionnaire survey with the selected experts to evaluate the priority and effectiveness of policy and policy packages to achieve

the Visions:

- 4) The fourth stage: to create the policy paths for each Vision, based on the responses from the experts:

The whole process involves two months interview and data collection from the government and other sources, including the government committee meetings minutes which provide essential framework to establish the future Japanese energy Visions.

5.1.5 Questionnaire Design

The questionnaire was divided into 3 sections, each section is consistent with descriptions of Visions and policy options. They are designed to obtain the experts' view on priorities and effectiveness of the policy options in respect to achieving a particular Vision. The purpose of the study, as well as the conceptual framework, is explained to the experts in the questionnaire. Any added comments on the policy options were welcomed. Questionnaires, created in digital format, were delivered through e-mail. This enables swift communication between the researcher and the experts, the former in the UK and the latter in Japan.

There are options common throughout Visions I, II, III and IV. The Vision I has 11 options and they are common to other Visions. The Vision II has 12 additional options, the Vision III has 17, and the Vision IV has 53 options. The Vision IV has more options, as its achievement requires more actions to be taken than the others, especially in the field of energy demand management. Also, in the Vision IV, the option categories were deliberately broken down to specific actions, in order to obtain the experts' views on them: for example, transport management can be treated as an option, but alternatively, more detailed issues were identified as options, such as lorry-sharing scheme. As a result, the number of the options under the Vision IV increased.

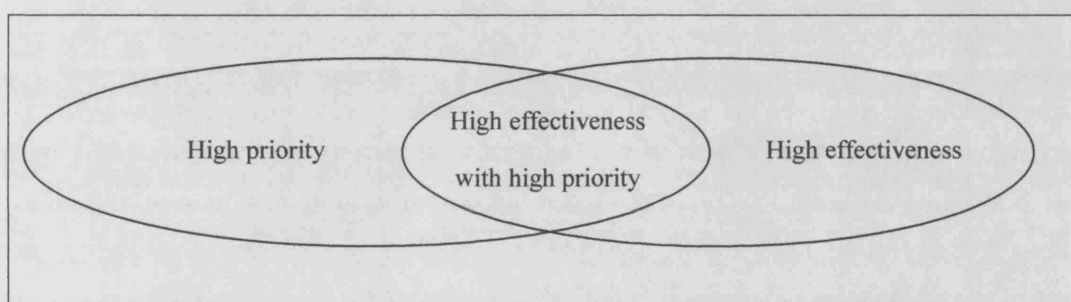
The options were grouped as Supply, Infrastructure, Market, Financial, Regulatory, Land-use, Cross-sectional and Social entries. These are, however, of indicative nature, as an option identified as in one entry often related to other categories.

5.2 Analysis of the Input from the Energy Experts

There are many policy options on which the experts generally agree about their

effectiveness and priority. There are also some options on which the experts agreed to be effective but have less priority. Also there are options that the experts agree to be less effective but highly prioritised. The options on which their opinions divided seem to indicate that they are the issues of controversy, and need more clarification and discussion.

Figure 5. 2: Overlap between priority and effectiveness



There are several options of which effectiveness and priority rates are largely agreed. Some options are highly rated for their priorities throughout the Visions, (e.g. tax reform) and it may suggest that they are the most urgent options, no matter which future Vision might be pursued.

The effectiveness and priority rates are generally in consistent. There are, however, some options which have high effectiveness, but lower priority ratings, and *vice versa*. For example, political decentralisation received high priority rate, though

its effectiveness was not seen as the highest. In contrast, the offshore renewable energy development has high effectiveness scores, but rated low in priority. The experts seem to be rating the priority option, not just on the basis effectiveness, but also on the political and social judgement e.g. in terms of the readiness of the option implementation. This means the first principles for priority (the principle of acceptability) is clearly understood by the experts.

There are some noticeable rating similarities which relate to the experts' backgrounds: Experts with NGO background give higher effectiveness/priority ratings to more options, while the experts with academic and industrial backgrounds gave generally reserved opinions to the options. Many options, however, gained the similar ratings regardless of the background of experts, therefore this research does not recognise significant biases arising from the experts' backgrounds. With the relatively limited number of experts, the research sees the expert's responses as indicative in nature, rather than conclusive: the responses are to form the basis for the policy packages, with necessary flexibility allowed for their interpretation.

Based on their evaluation, the next stage is to create policy paths, consisted with packages of the policy options. In the policy paths, consideration will be given to

the issues such as timing of policy change, resource implications, allocation of responsibility, and the degree of achievement of the target, etc.

5.2.1 Common Elements for all the Visions

5.2.1.1 Policy Option Description

Selected policies were packaged to form the “common elements”, which are identified as the options that need to be implemented irrespective of what Vision is follow, and are the *core* policies for all the policy packages. There are 11 common policy options. Those options, whose descriptions are given as follows, are thought to be fundamental for the achievement of all the Visions.

Supply-1: Increase of mini-hydro

Large-scale dams were extensively developed in Japan with 90% of the potentially available sites have been covered. As the development continues, a various environmental problems were recognised. Also, the financial requirement to build large-scale dams often threats local economy. Mini-hydro can be one of the most cost-effective and environmentally least harmful option, and they may have much potential in Japan to supplement other kinds of renewables.

There are many categories in small-scale hydro power: It generally means a maximum of 10 MW with “run-of-river” installation, but the size varies due to the lack of internationally recognised definition. There are commonly accepted references that mini-hydro means below 2 MW, micro-hydro below 500 kW and pico-hydro below 10 kW (Paish, 2002). The option (increase of mini hydro) includes not only schemes below 2 MW, but also those under this level, thus including “micro” and “pico” hydro installations.

Supply-2: Abolition of nuclear power

Since it was first introduced in Japan, nuclear power gets steady increase in the country’s whole power production structure. While contributing about 13 % of the total primary energy, nuclear power was not immune to criticism. The criticisms cover virtually the whole life cycle of power production through nuclear energy, including their site selection, costs of construction, operational safety and waste disposal. Reflecting on these criticism, phasing out of nuclear is one of the options to avoid catastrophe it potentially creates.

Phasing out of nuclear power would be not an unrealistic step, when potential of alternatives is carefully examined. The CNIC study, one of the researches

identified in the Chapter 3, was an example of such examination (Katsuta, 2001).

It argues feasibility of nuclear abolition in exchange of the rise of other energy sources.

Market-1: Domestic CO2 permit trade

This is to introduce domestic CO2 emission permits trading. Domestic CO2 trading could be stimulated by the appropriate level of "cap" provided to encourage industrial operators to reduce their emissions.

Market-2: Modify electricity price menu

This option is to differentiate the electricity price menu. Currently, there is not much difference between the peak and off-peak time electricity prices, discouraging consumers from reducing their peak time demand. The differentiated price menu could trigger price sensitive consumer behaviour, and ease the acute electricity demand at particular periods of time (e.g. air conditioning demand in summer afternoon).

Finanical-1: Electric Power Resources Development Special Account (EPRDSA)

The EPRDSA was introduced in 1974 with then prime minister Kakuei Tanaka's strong backing, as his initiative to "import" PWR from the US demands new

financial supporting mechanism. The new tax was a levy on electric power generation, in which the burden is simply transferred to electricity consumers (US\$ 4.05 for each 1,000kWh). The tax income is allocated to a special account called the Electric Power Resources Development Special Account (EPRDSA), which is distributed to fund acquisition of necessary sites for nuclear power stations and construction of the relevant facilities (Appendix B).

However, unexpectedly small demand for electricity, in addition to strong opposition to nuclear sitings, made the pace of nuclear power station construction very slow. This made the situation where the considerable portion of EPRDSA is not used, and has been accumulated over many years. The option is suggesting to allocate EPRDSA for new causes, e.g. development of renewable energy sources (RES).

Financial-2: Coal Tax

This option is to argue the imposition of tax on coal. As has been explained in the earlier, the coal is increasingly dominating the Japan's energy supply with its cheap prices. Coal is a main source of CO₂ and other pollutants, but is exempt from any duty, unlike any other imported fuels (except uranium for nuclear power), making it more attractive to the industry and utilities that use it.

Introducing coal tax may curb the demand, reducing CO2 emissions.

Regulation-1: CO2 consideration in EIA

This is to tighten CO2 consideration during EIA process. Currently, the CO2 element is fairly marginalised during the project EIA processes. To place the CO2 consideration at the heart of the EIA procedure is seen as important measure in order to control the emissions.

Regulation-2: Restrict fuel choice for independent power producers (IPP)

As mentioned in Chapter 2, after the 1995 amendment on the Electric Utilities Industry Law, a number of independent power producers (IPPs) entered the electricity production market. Many of them use cheaper fuel (namely coal) to produce electricity. This resulted in increased CO2 and other kinds of emissions. This option is to restrict fuel choice for IPPs, by imposing conditions on them to use less CO2 intensity fuels.

Regulation-3: Restrict IPP's market entrance

This is to restrict the number of IPPs entering the market, through direct regulatory control on granting the operating permission. This may go against the free-market principle, but experts may consider it a necessary option, given the

situation mentioned above.

Information-1: Product labelling

This option is to enhance the awareness of customers as to energy usage through their purchased products. Product labelling, which is increasingly available to the Japanese market, would be an effective means to communicate the degree of the product's energy efficiency.

Information-2: Pollutant Transfer and Release Registers (PRTR)

This is to disseminate information through the existing pollution information scheme, such as PRTR. PRTR has been established in Japan since 1999³, though its effectiveness is questioned (Suwa, 2000). One of its major setbacks is the absence of CO₂ listing in the current chemical substance register. This option is to suggest the expansion of the scheme to catalogue the CO₂ emission volume from each site. Information disclosure on individual sites would be not only instrumental to public awareness, but also to form a basis for accounting for CO₂ emissions trading both in the domestic and international markets.

³ The PRTR Law, officially named as the Law Concerning Reporting, etc. of Releases to the Environment of Specific Chemical Substances and Promoting Improvements in Their Management, was enacted in November 1999, implemented in March 2000.

5.2.1.2 Experts' verdict

There are 11 policy options common to the Visions I, II, III and IV. The scores gained by each option vary, reflecting the importance and urgency attached to them. As the Figure 5.4 describes, the option with the highest score within the common elements is to reallocate EPRDSA (Financial-1), the special budget currently being used to mainly finance nuclear and other existing fuel technology research, to gas infrastructure construction or to renewable energy sources (RES) and energy efficiency development.

The Financial-1 option is followed by the Increase of mini-hydro (Supply-1), Domestic CO₂ permit trade (Market-1), Coal Tax (Financial-2) and Product labelling (Information-1) options.

Increase of mini-hydro (Supply-1) did gain high priority ratings. However, the potential introduction capacity and the current level of power extraction from mini-hydro dams are regarded as limited, making the option's effectiveness slightly moderated.

On Domestic CO₂ permit trade (Market-1), one expert suggests the earlier

adoption of the domestic CO₂ permits trading scheme could help the industrial operators to be familiarise with the relevant rules and procedures, prior to join the similar scheme which will be internationally available in the near future.

Most of the experts seem to see the Coal Tax (Financial-2) is a necessary step to reduce the CO₂ intensive fuel use.

The effectiveness of Product labelling (Information-1) was a matter of divided opinions, but the combination of product labelling and electricity consumption information was thought to enhance the awareness of consumer and to lead to their energy saving behaviours.

The above options were followed by Modify electricity price menu (Market-2), CO₂ consideration in EIA (Regulation-1), Restrict fuel choice for IPP (Regulation-2) and PRTR (Information-2) options.

One notable comment was given from an expert on the Modify electricity price menu option (Market-2) that the differentiated prices should be the result of a various market policies, rather than a policy option itself. This suggestion is extremely important as it poses a question as to how the market and prices should

be designed in the increasingly liberalised energy market in Japan.

One expert commented on CO₂ consideration in EIA (Regulation-1) that the identification of CO₂ emission volume at site level is important, but the integration of CO₂ element to EIA procedure could be technically difficult.

Many experts agree that there should be mechanisms to ensure renewable IPPs not to be precluded from their competition with fossil fuel IPPs. The regulatory option, such as Restrict fuel choice for IPP (Regulation-2), is, however, not seen by them as an appropriate measure to achieve the purpose.

The above options were followed by Abolition of nuclear power (Supply-2) and Restrict IPP's market entrance (Regulation-3).

The experts see those options highly controversial. For example, there are many experts commented on Regulation-3 that it can be against the fair competition rule in the energy market. Also experts' opinion divided on Supply-2, which is to propose gradual phasing out of nuclear power stations under this Vision.

Figure 5.3 11 Key elements throughout Visions

(Supply)				
	increase mini-hydro (47)			abolition of nuke (23)
(Market)				
	CO2 permit trade (46)	electricity price menu (42)		
(Financial)				
reallocate EPRDSA (55)	coal tax (48)			
(Regulation)				
		CO2 in EIA (42)	limit IPP's fuel choice (33)	limit IPP's market entrance (7)
(Information)				
	product labeling (47)	PRTR (43)		

5.2.2 Policy Package for Vision II

Under the Vision II, the main emphasis is on fuel switch from coal to gas. The policy options were packaged to trigger the switch. The Vision II has 11 common and 12 individual options. The followings are their descriptions (the core option explanation will not be repeated here, as they appear in the previous section)

5.2.2.1 Policy Option Description

Supply-3: Convert coal power station to gas use

This is to convert coal-fired power stations to natural gas-use. The CO₂ intensity of natural gas is far less than that of coal, therefore the natural gas combustion at many power stations could result in the reduction of CO₂ emissions. The conversion requires minimum technical support and has already been adopted in some countries. (e.g. a “dash-for-gas” phenomenon mainly during the 90s is a typical example of such fuel switch (Eikeland, 1998)).

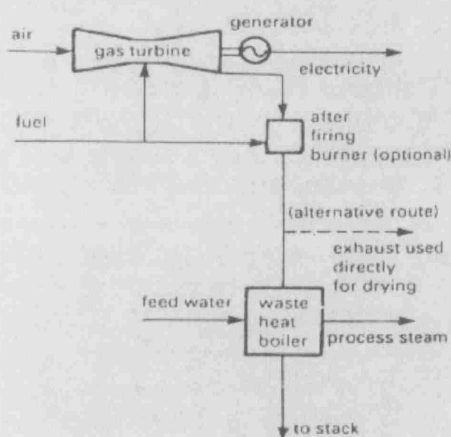
Supply-4: Advanced gas power technology

This is to introduce advanced gas technology such as combined cycle gas turbine (CCGT). CCGT technology is to produce electrical power from both a main

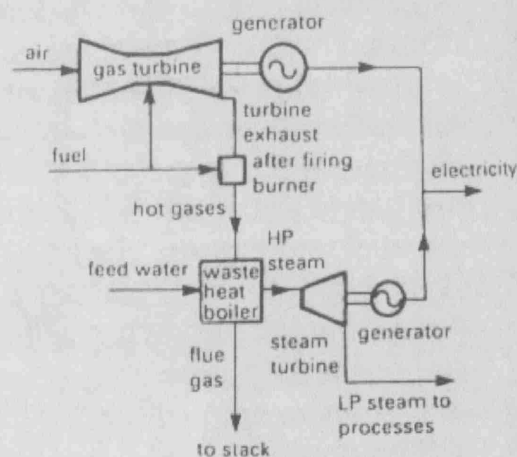
turbine, fuelled by natural gas (or oil) and a turbine supplied with the steam (generated by the exhaust gases from the main turbine). The thermal efficiency of these stations is about 50%, compared with a maximum of 40% from steam turbine coal-fired power stations. The construction period for this type of power stations is much shorter (about 2 years) than the others which use the fuels such as nuclear and coal (Porteous, 1996). The technology could be applied to not just on power stations, but also on the existing boilers for industrial and other uses.

Figure 5. 4: Mechanism of Combined Cycle Gas Turbine (CCGT)

Gas turbine CHP plant



Combined cycle CHP plant



(Source: Porteous, 1996)

Supply-5: Define gas as a baseload fuel

This option is against the background that coal is being one of the baseload fuels for Japanese energy structure, contributing to the increase of CO₂ emission. If gas is established as a baseload fuel, significant amount of the CO₂ emission would be reduced.

Supply-6: Improve power production efficiency

This is to improve the existing fossil-fuelled power station efficiency by compulsorily requiring retrofitting combined cycles. As is in the case with CCGT, retrofit combined cycle can be fuelled by the exhaust steam of the main generator, thus improves the overall efficiency of the power stations by about 10%.

Infrastructure-1: To construct international and domestic gas pipeline

Japan has only 6% of pipeline coverage, far less degree compared to other developed nations (Chapter 2). This is largely due to the fact that there has been less discovery of natural gas deposits around the country, making it dependent on liquidised natural gas imports from abroad.

The situation, however, has been changing, and the necessity to develop pipelines is increasingly recognised. The recent development of Sakhalin natural gas

depository, for example, identifies Japan as one of the potential markets, and made the international developers (such as Exxon) to start to seek customers in Japan (MRI, 2000).

If construction of international and domestic gas pipelines ever becomes the reality, its impacts to the supply context will be enormous. In fact, most of the Supply and Infrastructure options will be triggered by pipeline gas availability: In other words, many of the Vision II options are largely dependent on the success of pipeline development, which means that this measure would be given a high priority (principle of long lead-time) by the experts.

Also, its effect on the market will be significant. The recently initiated competition between the gas and electricity industries in Japan, which are currently in favour of the electricity industry, will dramatically change, as the quality and quantity of infrastructure available to gas-dependent players increase.

Infrastructure-2: To increase the CHP penetration

CHP jointly produces heat and power, and it is least polluting especially if natural gas is applied as its fuel. The natural gas CHP can be installed in densely populated areas, as it emits less CO₂ and produces practically no SO₂. This option

is probably the good example to exhibit the extent to which the Vision II options rely on the pipeline construction.

Market-3: To make Micro Gas Turbine (MGT) more available by restructuring regulations

MGT is to burn gas in small scale turbine (micro gas turbine). As the wider penetration of MGT will lead to the de-centralised energy production, it would be necessary to be placed along the line with the market liberalisation which currently taking place in Japan.

Market-4: To encourage the competition between gas and electricity industries

The market liberalisation, initiated in the 1990s, has already created some competition between gas and electricity industries, but the poor gas infrastructure has allowed the electricity industry to dominate. Nevertheless, competition between gas and electricity would be increased if more necessary policies are in place.

Market-5: To liberalise gas industry

As in the case of Market-4, the limited accessibility to natural gas made the competition among gas industry inactive, though the liberalisation has been

initiated. The construction of the pipeline may dramatically change the situation.

Market-6: Connect gas users with main gas pipeline

There are still many households and other gas users do not have access to the main gas pipeline. They are relying on mobile gas tank, for example, to use the fuel. Connection of those gas users with the pipeline may increase the attractiveness of the gas.

Financial-3: Reallocate petroleum account

The petroleum account (Formally termed as the Petroleum/Petroleum Alternative Energy Special Account (PPAESA)) currently finances a various petroleum projects (Chapter 2. Also see Appendix B). This option is to re-allocate the budget from the existing purposes to support renewable energy sources (RES) and energy efficiency R&D. This option is along line with the core option (Financial-1: re-allocation of special energy budget to gas pipeline construction), in terms of energy budget re-structuring.

The Financial-4 option: To finance pipeline with Japan's ODA budget

This option is based on the assumption that it would be easier for the industrial decision-makers to accept gas pipeline construction if the government financially

support the project. Japan's overseas development aid (ODA) budget has been often distributed to a various international project⁴. It would be possible to integrate the necessity of donor country (Japan) and the recipient countries to develop pipelines through ODA.

5.2.2.2 Experts' Verdict

Convert coal power station into gas use (Supply-3) and Reallocate the Petroleum Account (Financial-3) were highly valued by the experts, with overall scores over 50.

It is, however, identified by an expert that converting coal power station into gas use (Supply-3) is feasible only when the sufficient amount of natural gas is available with reasonable prices. The option, therefore, will be economically viable when the other policies are in place to ensure this precondition is satisfied.

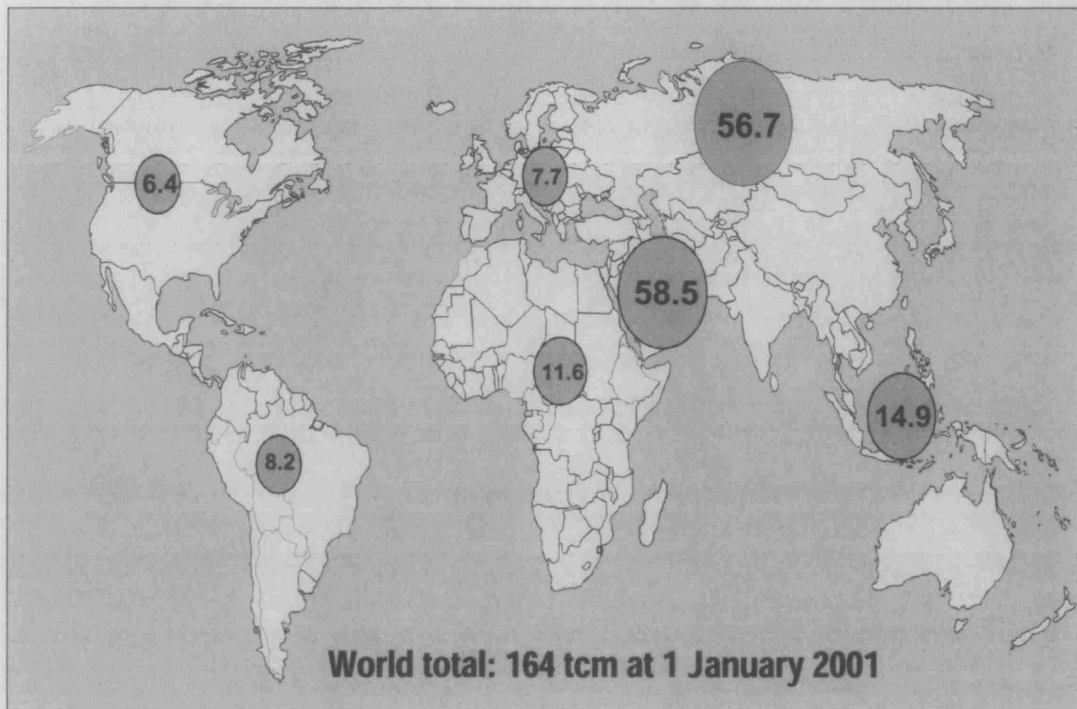
Options which follow the above include Advanced gas power technology

⁴ There have been a number of cases in which Japanese corporation gain the benefit, rather than recipients. In March 2003, over 4000 Indonesian residents in Sumatra island brought Japanese government and aid agencies to court, claiming compensation for the loss of their livelihood. They claimed that a Koto Panjang dam construction, one of the Japanese overseas aid programmes destroyed their means of living, culture and ecosystem (Jiji Tsushin, 2003).

(Supply-4), Define gas as a base-load fuel (Supply-5), To construct international and domestic gas pipeline (Infrastructure-1), To increase the CHP penetration (Infrastructure-2), To make MGT more available by restructuring regulations (Market-3) and To encourage the competition between gas and electricity industries (Market-4). All those options are widely associated with a fuel switch from coal to gas.

Given the growing international interests into gas utilisation, as well as the proven gas reserves, an expert identifies Construct international and domestic pipeline (Infrastructure-1) as the most needed option. It was also reminded by the expert that consideration must be given to the scale of effect through this option: the "dash for gas" phenomena, demonstrated in some of the countries such as in the UK, would be inevitable once the gas infrastructure is provided.

Figure 5. 5: Proven Gas Reserves



(Source: IEA 2001)

One expert, though he gave a positive evaluation to Define gas as a base-load fuel (Supply-5), warned that the demand management should be in place, prior to adopt a supply policy option dependent on natural gas.

The completion of pipeline will enable supply of the natural gas to be used in facilities such as CHP (Infrastructure-2). There are some reservations made by the experts that the CHP is only effective in countries where constant heat supply is

required. The Japanese heat demand is not as consistent as those in some of the European countries, thus extensive CHP programmes demonstrated in those countries, such as Denmark, could not be relevant to the Japanese context. One expert suggest that fuel cells, for example, would have much more potential than CHP, as it produces heat and electricity near at the point of consumption, thus reducing the heat loss inherent to CHP.

The less favoured than the above are Improve power production efficiency (Supply-6) and To liberalise gas industry (Market-5) options.

On the option to improve power production efficiency through retrofitting combined cycle (Supply-6), one expert suggested it is more economically efficient to replace old coal (or oil) fuelled power stations with new facilities, rather than applying the retrofit. That is because some oil-fuelled power stations are only in use to satisfy the peak demand, thus there is little incentive for the operators to invest on retrofit combined cycle on those stations.

The option to finance pipeline with Japan's ODA budget (Financial-4) was poorly evaluated by the experts. Many experts pointed out the purpose of the ODA should not be mixed up with the Japan's national interest. This means the experts

prefer other financial resources than ODA, regardless of public or private, to be used for the gas pipeline construction.

Figure 5. 6 Policy evaluation for Vision II

(Supply)				
	increase mini-hydro (40)			abolition of nuke (16)
(Market)				
	CO2 permit trade (42)			
	electricity price menu (42)			
(Financial)				
reallocate EPRDSA (53)				
coal tax (54)				
(Regulation)				
		CO2 in EIA (39)	limit IPP's fuel choice (34)	limit IPP's market entrance (5)
(Information)				
	product labeling (46)			
	PRTR (42)			

(Supply)				
convert coal to gas (50)	advanced gas station (48)	improve PS efficiency (30)		
	gas as base-load fuel (42)			
(Infrastructure)				
	gas pipeline (45)			
	increase of CHP (43)			
(Market)				
	micro-gas turbine (46)	liberalisation of gas (34)	connect gas uses with pipeline (27)	
	competition gas vs. electricity (40)			
(Financial)				
allocate petroleum account (53)				ODA to gas pipeline (18)

5.2.3 Policy Package for Vision III

The focal point of the Vision III is renewable energy development. The policy options that could be associated with renewable extension are packaged. There are 11 common options and 17 individual options prepared under the Vision III. The classification of the options based on the scores is as follows (the core and some options' explanation will not be repeated here, if they appear in the previous sections).

5.2.3.1 Policy Option Description

Supply-7: Fuel cells for transport

The fuel cell is a device to directly convert chemical energy to electrical energy normally by splitting hydrogen into ions and electrons. There has been a controversy as to what fuel finally dominates the supply of hydrogen.

Large-scale manufacturers are competing on the different technologies for fuel cells application. For example, GM-Toyota alliance is co-developing petrol-based fuel cell, whereas Daimler and Mitsubishi are investing in the methanol-based hydrogen fuel cells. Gasoline-based fuel cell, however, has little to contribute to

the overall reduction of fossil fuel dependency, though the practical application of the technology is much easier, as it can count on the existing infrastructure for petrol supply. It is unknown which technology will finally prevail, but it would be sensible to prepare necessary supporting mechanisms, including hydrogen infrastructure, for fuel cell vehicles.

Supply-8: Introduction of Feed-in tariff

The feed-in tariff is made up with an obligation for electric utilities to compulsorily purchase renewable energy sources-electricity (RES-E) from independent producers, and to pay feed-in tariffs for the RES-E purchase. The tariff, which is set up by regulators, should exceed long term marginal costs of the RES-E production, thus it reduces financial risk for the independent renewable electricity producers, and to improve profitability of the plants (Schaeffer, *et. al.*, 1999). The system is operated in some European countries, such as Germany, to contribute to the steady growth of renewable electricity.

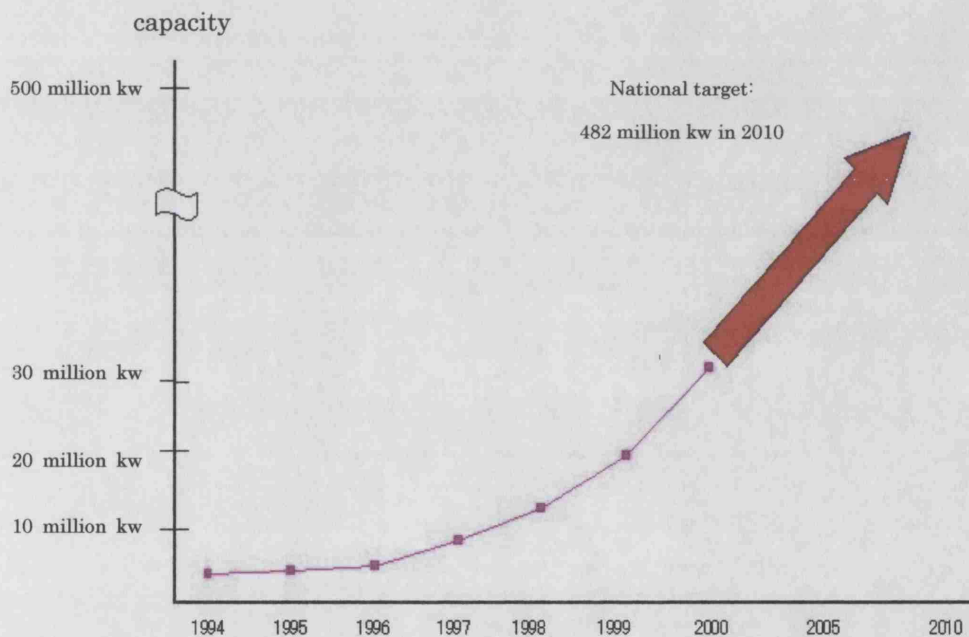
Supply-9: Give subsidies to renewable investment

The ANRE had a programme to give subsidies to domestic solar power instalment. For example, the subsidy scheme existed since 1994 to 2001 for solar power⁵, and

⁵ To be precise, the solar power subsidy scheme is consisted with two projects. The Solar Power

it produced substantial capacity increase (Figure 5.7). There are, however, criticisms that the subsidy schemes should not only provide an incentive for equipment installation, but also for energy "generation"⁶. The questionnaire is designed to obtain expert views on the appropriateness of subsidies for investment in renewable energy sources.

Figure 5. 7: Solar Power Capacity Increase in Japan



(Source: Japan Photovoltaic Energy Association, homepage)

System Monitor Project for Domestic Buildings started in 1994 until 1996. The project is to give subsidy (1/2 of the cost). The total budget was about ¥2-3 billion (US\$ 18-27 million). In 1997, the project was taken over in by a new scheme to provide 1/3 of the cost for solar power installation. The new scheme's budget was drastically increased to ¥ 11-16 billion (US\$ 100-145 million).

⁶ There are allegations that some parts of the budgets were unfairly distributed, only to benefit those who claims overestimation of the installation costs (Nakagawa, 2001).

Infrastructure-3: To give priority to renewable electricity and its grid connection

There is an electricity surplus purchase scheme voluntarily operated by the electricity utilities. The utilities, however, established a certain threshold for intermittent electricity, such as wind power, to be connected to their grid (The Tohoku Electricity with 300 MW/3 years and Kyushu Electricity with 150 MW/3 years). As a result, some renewable electricity producers were refused their grid access. The option is designed to avoid such situations by giving priority to renewable electricity to the grid connection.

Infrastructure-4: Develop offshore-wind/solar electricity production capacity

Unlike some countries, such as Denmark or Netherlands, there is no plan to develop offshore energy capacity in Japan. Financial and other incentives for the investment are the key to this option, especially in Japan where geographical condition is less favourable for offshore wind power, pushing the cost of such development upward.

Infrastructure-5: Support foreign countries to produce renewable energy

Countries such as South Korea and Taiwan, as well as China, have a great potential for developing its renewable resources. In fact, in Taiwan, it is estimated

that there would be about 1500 MW micro-power generation market by around 2010 (HsiehLeeSCG, 2001), and there is no reason why solar power should not play a significant role in the micro-power market. Through mechanisms such as CDM, renewable development in the vicinity country can contribute to the Japanese credit for CO2 reduction.

Infrastructure-6: imposition of renewable generation obligation for buildings

Renewable energy infrastructure, such as solar power and heat installation, is financially advantageous especially when they are integrated with building modules. By installing them on the surface of buildings, electricity and heat is produced at the point of use, minimising the energy loss through their transmission. It also requires no additional land, or separate support structure (Schoen, 2001). Policy option to ensure the new buildings being equipped with renewable energy generation facilities (e.g. through regulation) may boost their overall capacity increase.

Infrastructure-7: Import renewable electricity from neighbouring countries

As mentioned in the infrastructure-5, many of Japan's neighbouring countries have great renewable capacity potential. Development of grid system to physically import such renewable energy to Japan could encourage their

development.

Market-7: Horizontal split of the electricity industry

The existing electricity utilities are operating the grid business in Japan. As mentioned in the Infrastructure-3, there have been some cases where small-scale renewable generators were refused connection to the grid on technical grounds. As well as giving grid connection priority to the renewable electricity, opening of the grid through horizontal split of electricity industry may ensure the equal opportunity to all energy generators.

Market-8: Green electricity certificate trade

Tradable green electricity certificate (TGC) is a mechanism through which the value of "greenness" or "renewableness" of renewable electricity is separately traded from the sale of physical electricity. Separate trade of the value associated with "green" electricity sources, could allow flexibility to develop renewable development in the most economically attractive sites (ECN, 2001). The market has been emerging in several countries, especially in Europe, such as Austria, Belgium (Flanders), Italy, the Netherlands, Sweden, Denmark and the UK (*ibid*)⁷.

⁷ There is an EU sponsored scheme called Renewable Energy Certificate System (RECS), which is testing the compatibility of green certificate among different countries. Their website has country reports which illustrate the progress of the scheme (www.recs.org).

The potential of the TGC in Japan has been so far explored by a single company, called the Japan Natural Energy Co. Ltd. (a spin off of Tokyo Electric Power Company) which is pioneering a programme to sell TGCs to the companies such as Sony, Toyota, etc⁸. The expansion of the TGC market may stimulate renewable electricity production.

Market-9: Allocate quota for renewable supply

There is a system known as renewable portfolio standard (RPS) available or discussed in countries such as the UK, Denmark and some states in the US. This is a system to allocate a certain amount of renewable energy supply obligation to energy players (generally to utilities). The system has an advantage to secure the specific supply of renewable electricity. Many countries which adopt (or will adopt) RPS combine it with tradable green certificates as a compliance tool for meeting the obligation.

It is practically impossible to have this option and Supply-8 option (Feed-in tariff) at the same time. The RPS specifies the regulatory requirement on renewable purchase volume. While securing at least minimum renewable development

⁸ Further information on JNEC is available at <http://www.natural-e.co.jp/>

through the required volume, it could also work as a “cap” to keep the renewable development at certain level. Under the Feed-in tariff, renewable generation does not have such constraint. It will be interesting to see which of the options between this or Supply-8 (Feed-in tariff) option get a higher evaluation by the experts.

Financial-5: Re-allocation of general budget to renewable energy

Energy-related revenue is largely divided into the general budget and special purpose budget. 70% of the energy-related general budget goes to the Coal Special Account (CSA) and the Petroleum/Petroleum Alternative Energy Special Account (PPAESA) in order to finance a various coal and petroleum related projects. The rest of the budget is allocated to nuclear R&D, the contribution to the International Atomic Energy Agency (IAEA) and energy technology R&D. The share for the nuclear R&D is the largest among all as shown in the Table 5.4. The option is designed to obtain the experts' view on the re-allocation of the general budget to the R&D of renewable energy.

Table 5. 3 The use of the energy-related general budget

Energy-related general budget total	¥ 165.1 billion (US\$ 1.5 billion)
Nuclear R&D	¥ 157.4 billion (US\$ 1.4 billion)
Contribution to IAA	¥ 6.3 billion (US\$ 57 million)
Energy R&D	¥ 0.3 billion (US\$ 2.7 million)
Others	¥ 1.1 billion (US\$ 10 million)

(Source: JACSES, 2000)

Financial-6: Introduction of carbon tax

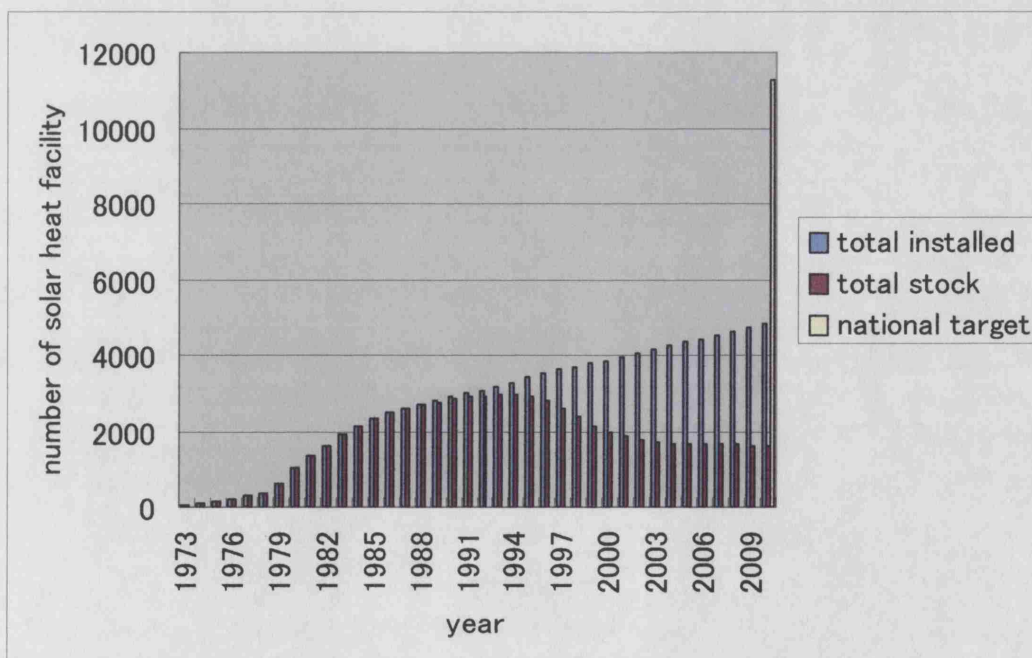
Currently, the energy tax rates are not incremental to fuel carbon-intensity. As a result, a coal share in the energy structure is increasing. The electricity market liberalisation in 1995 to allow independent power producers to enter the market also have contributed to the coal increase in the electricity sector, as the IPPs found the coal as the cheapest fuel, giving them advantage to challenge the existing players. The amount of coal consumed by the electricity sector, for example, was 52 million tonnes in 1999, nearly double the 1990 level of 27 million tonnes (FEPC, 2000). To co-ordinate the fuel taxes and carbon intensity of fuel types can give key signals to the energy producers to reconsider their fuel choices.

Financial-7: To give subsidies to support thermal equipment

There are several technologies emerging to satisfy residential sector's thermal demand through e.g. solar heat and geothermal technologies. However, the total number of thermal installations is declining. Especially for solar heat, which once was particularly popular after the oil crisis, the capacity is shrinking as people do not replace them with new systems. Also against the background of relatively cheap fuel prices, many companies which used to manufacture the solar heat

utilisation system withdrew from the market. Nonetheless, the government target for heat utilisation is ambitious. For example, it assumes 4.5 million kloe by 2010 for solar heat (which is equivalent to nearly 12 million solar facilities), compared to 1 million kloe in 1996 (which is about 3 million facilities), as shown in the Figure 5.9. If there is little supporting mechanism for heat technologies, particularly for their domestic application, the ambitious target will certainly not be met. Financial support for their installation may help to maintain the demand for those systems.

Figure 5. 8 Solar heat target and reality



(Source: Solar System Development Association, 2001)

Financial-8: Tax exemption for green certificate purchase

In November 2000, the Japan Natural Energy Company (JNEC) is established to intermediate green certificate trades. So far it attracted 20 corporate customers including Sony, Toyota and Hitachi Electric with the total volumes for 25.5 million kWh/year. The customers enter a 15-year contract to purchase green certificate issued by the JNEC. JNEC is expecting to expand its contracts and the market is estimated to grow 10 fold, if the appropriate government policy is available.

Currently, the government tax office does not recognise the cost of JNEC-issued green electricity certificate as a necessary expenditure for company operation. This means the companies which join the JNEC scheme cannot claim tax deduction upon their green certificate purchase. The JNEC sees this issue as a main obstacle to the future success of the scheme, and is pressing on the government to change the current taxation system. So far, however, the lobbying activity has been hampered by the government's resistance.

Regulatory-4: Imposition of stricter energy efficiency standards

The technological development has produced substantial energy efficiency

improvement for vehicles, but the energy efficiency standards are not equivocal to the progress. Also, some types of diesel vehicles, such as large-sized trucks, bus and small-sized passenger cars are excluded from the vehicle efficiency regulation. To tighten the standards and impose penalty for non-compliance could contribute to vehicle efficiency improvement.

Land use-1: Revise land use regulations

Although the potential renewable energy endowed to Japan is huge, the current land-use regulation restricts the accessibility of such resources. For example, much of the strong wind appropriate to power generation is available in the National Park boundaries. In order to develop wind energy, restructuring of the National Park Law is required.

In addition to the renewable energy, man-made energy availability also depends on land-use strategy. For example, deployment of exhaust heat from factories requires appropriate planning design: Although there are increasing numbers of cogeneration projects, the widespread of heat utilisation is yet to be seen. Planning law and other regulations should be organised to enable effective use of exhaust heat from various sources.

5.2.3.2 Experts' Verdict

There are several options which were highly valued by the experts. Those include: Introduction of Feed-in tariff (Supply-8), To give priority for renewable electricity for grid connection (Infrastructure-3), Re-allocation of general budget to renewable energy and energy efficiency (Financial-5), Introduction of carbon tax (Financial-6), To give subsidies to support thermal equipment (Financial-7) and Revise land use regulations (Land Use-1).

Many experts gave high effectiveness and priority scores to the Introduction of Feed-in tariff (Supply-8), which is to secure the renewable investment and to increase the capacity. One expert commented this as an "essential" option to encourage renewable energy production.

Also, experts consider the option to give priority to renewable electricity for grid connection (Infrastructure-3) as effective and urgent. On the other hand, There is a concern that electric current disturbance may caused by greater renewable injection to the grid. Against this background, an expert commented that to technically improve the capacity and system specifications of the existing electricity grid is necessary, before giving access priority to renewable electricity.

Many experts was in their favour of re-allocating the general budget to renewable R&D and subsidy (Financial-5). For the introduction of carbon tax (Financial-6), the effectiveness could largely be dependent on the tax rate. Also, an expert commented that imposition of carbon tax on imported coal might cause serious "trade war" with the countries with which Japan has a long-term contract for coal import. Nevertheless, the option was identified as having high priority.

To give subsidies to Support thermal equipment (Financial-7) was generally favoured by the experts. The Revision of land use regulation (Land Use-1) is also broadly supported by the experts. One expert, however, cautioned that a care must be taken so that renewable is not been used to excuse any development in naturally sensitive areas.

The above were followed by the following options: Fuel cells for transport (Supply-7), Develop offshore-wind/solar electricity production capacity (Infrastructure-4), Horizontal split of the electricity industry (Market-7), Allocate quota for renewable supply (Market-9), Tax exemption for green certificate purchase (Financial-8), Imposition of stricter energy efficiency standards (Regulatory-4)

For the option of Fuel cells for transport (Supply-7), there was a discussion on its fuel choice. One expert gave a view that as there is not sufficient biomass in Japan to provide necessary amount of methanol for fuel cells, natural gas can satisfy a majority of hydrogen demand. Another expert preferred transport demand management than the technological solution as the fuel cell deployment.

Develop offshore-wind/solar electricity production capacity (Infrastructure-4) got modest scores. The reason may be lie in the fact the geographical severity of the Japanese coast would increase the scale of financial requirement for such development.

Also relatively moderate evaluation was given to Horizontal split of the electricity industry (Market-7). There is, however, a strong view that this option forms a prerequisite for any decentralised power production and consumption. The horizontal split, therefore, should be on agenda for the Japanese energy industry's liberalisation programme.

Allocate quota for renewable supply (Market-9) did not get as high evaluation as the Feed-in tariff option (Supply-8). One expert suggested the difficulty of

preparing transparent procedure which is necessary to establish meaningful quota target. Also, Feed-in tariff was favoured as a market incentive to encourage renewable energy demand, while the quota system is seen as potentially harmful measure which may cap the renewable supply capacity at certain level.

Less appreciated options include: Give subsidies to renewable investment (Supply-9), Support foreign countries to produce renewable energy (Infrastructure-5), imposition of renewable generation obligation for buildings (Infrastructure-6), Development of green electricity certificate trade (Market-8), Import renewable electricity from neighbouring countries (Infrastructure-7)

Some experts gave modest scores for Give subsidies to renewable investment (Supply-9). There are opinions that giving subsidies for capacity instalment is not an efficient measure, and could distort natural development of renewable market.

There was a mixture of responses towards Support foreign countries to produce renewable energy (Infrastructure-5). Some experts consider appropriate mechanisms should be in place to ensure the foreign renewable development is linked to Japanese credit.

Several experts do not agree with the imposition of renewable generation obligation for buildings (Infrastructure-6), as they see the regulatory imposition is not preferable way to encourage renewable generation.

Importing renewable electricity from neighbouring countries (Infrastructure-7) was least valued by many experts. The reasons provided include the following.

- 1) Energy loss is too huge to justify the physical grid connection.
- 2) It would be technically difficult.
- 3) The electricity prices gap between the neighbouring countries and Japan could lead to the collapse of Japanese renewable industry.
- 4) It is also probably against the international trade rule to be selective in purchasing particular types of electricity (importing only renewable electricity would be difficult).

Figure 5. 9 Policy evaluation for Vision III

(Supply)				
	increase mini-hydro (47)	abolition of nuke (34)		
(Market)				
	CO2 permit trade (45)	elec. price menu (36)		
(Financial)				
reallocate EPRDSA (58)	coal tax (45)			
(Regulation)				
	CO2 in EIA (45)		limit IPP's fuel choice (29)	limit IPP's market entrance (3)
(Information)				
	product labeling (48)	PRTR (39)		
(supply)				
feed-in tariff (61)	fuel cell for transport (40)	subsidy to renewables (38)		
(Infrastructure)				
renewable grid connection (53)	offshore wind/solar (40)	support foreign renewables (37)		renewable import (18)
		renewables for housings (36)		
(Market)				
	horizontal split electricity industry (47)	green electricity trade (33)		
	renewable quota (44)			
(Financial)				
general budget (55)	renewable purchase (49)			
carbon tax (52)				
thermal equipment (51)				
(Regulatory)				
	fuel efficiency standards (48)			
(land-use)				
revise regulations (55)				

5.2.4 Policy Package for Vision IV

The key features for the Vision IV options are the combination of supply strategy and energy demand management. There are more options covered under the Vision IV, with 11 common options and 53 individual options. It is to reflect the degree of change required to achieve the Vision IV targets. The following summaries give the policy option descriptions (the core option explanation will not be repeated here, as they appear in the previous sections. Also, some options are shared with the Vision II and III, and their descriptions are not duplicated.)

5.2.4.1 Policy Option Description

Supply-10: To prepare heat strategy

In Japan, there has been little attention paid towards heat management issues. Although Japan is a relatively warm place compared to many of the OECD counterparts, substantial heat demand does exist. Compiling the national statistics on heat demand, which is currently absent, should be recognised as an urgent task for the government. Also, the compiled statistics should form the basis for the national and local heat management strategies.

Supply-11: Biomass Electricity

Biomass is increasingly recognised as a fuel with great potential for CO₂ emission reduction, due to its carbon neutrality. Japanese forests in general have been experiencing severe damage through over-planting of coniferous trees. The neglect during the post WWII period further exasperated the forest condition. These forests need urgent management, involving selective tree cutting. The cut-down trees can be used as biomass fuel.

Supply-12: Change the baseload fuel

The Japanese government currently places the nuclear as a baseload fuel. From the sustainability perspective, however, renewable energy would be much better suited for the baseload role. This option is to make the renewable energy as the first baseload fuel, and the natural gas as the second.

Infrastructure-8: Develop electricity storage system

In the UK, it has been reported that the Innogy, the UK arm of National Power, is developing electricity storage facilities at a commercial scale (ENDS, 2000). Japan is also taking up an initiative on electricity storage application programmes (Kyodo, 2001b). The electricity storage has a great advantage for revolutionising

energy planning. For example, renewable electricity can be stored in the form of hydrogen, and delivered when needed.

Infrastructure-9: Reduce high voltage transmission

It is inevitable that electricity is lost when it is transmitted through electricity grid. In Japan, average 5% of the electricity is wasted during the transmission. Also there are allegations that high-voltage transmission contributes to health impacts (Henshaw, 2002). Limiting the high voltage transmission could reduce the inefficiency and health effects.

Infrastructure-10: Telecommuting

The advancement of information technology enables communication between distant places at high speed. Also the volume of information transmittable at once is dramatically increasing. This phenomenon is much debated in line with less demand for physical transportation (Mitomo and Jitsuzumi, 1999). On the other hand, some argue that information exchange signifies more complex relationship and it may actually increase the transport demand (Hjorthol, 2002), (Lyons, 2002). The option is designed to get the experts' views on how telecommuting contributes to the reduced demand for transport.

Market-10: Liberalisation of energy production

Energy production has been rather restricted to large-scale utilities. The 1998 amendment to the Electricity Utility Law introduced wholesale tendering system for large-scale fossil power generation. The small-scale generators have numerous disadvantages competing with them. The market restructuring should proceed to ensure the level-playing field in which the small-scale generators compete with others.

Market-11: Combine green electricity certificate and CO2 permits trade

There has been a debate that a green certificate could also represent CO2 reduction credit, therefore it could be redeemed in the CO2 emission permit trade (Boots, 2003). By combining both, efficiency may be achieved, though there is a need to clarify the role and value of combined credits.

Market-12: Allow more customers to negotiate directly with electricity suppliers

It is to allow more customers to negotiate directly with electricity suppliers. The partial market opening has already started by the amendment to the Electricity Utilities Industry Law, giving large-scale customers (over 2000MW annual purchase) to directly negotiate with suppliers/generators. The small-scale customers are not given the choices of energy company nor energy products they

purchase.

The direct negotiation is, however, the imperative for customers to choose different types of energy/electricity. For example, systems e.g. the green electricity pricing, which is to trade renewable-origin electricity with premium prices, is precluded from the market, if the customers do not have right to directly negotiate the energy menu with their suppliers. Further market liberation to allow more people to enter direct negotiation is thus a prerequisite for untapping demand for emerging energy products.

Market-13: On-site energy de-regulation

Currently, on-site energy production and consumption are not much available. Behind this, there are several regulations being as obstacles for their market penetration. For example, detailed technical standards for commercial thermal power production are required for micro-gas turbine for home use. Also, grid connection cost has to be borne by those who install MGT, which cost over US\$ 40,000 regardless of the facility size. These regulations would have to be changed if MGT is to be more commercially available.

Market-14: Gas-Direct negotiation

After the gas market liberalisation in 1990s, direct negotiation between large-scale customers and gas suppliers initiated. Direct sales for the smaller scale customers are, on the other hand, yet to be started. This option stands on the assumption that competition among gas suppliers may reduce the price of gas, allowing the greater use of gas by consumers. As the gas has smaller CO₂ intensity, its wider use may contribute to the reduction of overall emission volume.

Financial-9: To support on-site energy production

Electricity produced in large-scale power station cannot be transmitted without loss (average 5% of electricity is lost during the delivery process in Japan). Heat is also distance-sensitive: it cannot be transported over a very long distance.

Recent technologies (such as micro-gas turbine, micro-CHP and fuel cells) have enabled energy production, which is small enough (usually below 5kw) to operate in domestic premises. The energy production on the site of consumption is advantageous, as it can avoid the transmission loss. It is also efficient in a sense that the energy production is carried out when the energy is required. Thus the on-site energy production should be encouraged, perhaps through financial incentives, so that the more people can adopt the technology at home.

Financial-10: Restructure tax for passenger vehicles

The tax system for vehicle is not linked with efficiency. For example, the 1989 abolition of goods tax resulted in encouraging customers to purchase large-sized vehicles (as has been reviewed in the Chapter 2). It has been felt by many that restructuring several vehicle taxes in accordance with fuel economy is a key to give efficient cars a competitive edge (Mizutani, 2000).

Financial-11: Virgin material tax

One of this Vision's goals is to reduce the size of material consumption. Recycling of material is a key for the reduction. Tax on virgin material can work as the incentive. The virgin material tax concept is gradually getting public support. A local authority, for example, started to impose ¥5 (US\$ 0.045) tax per a supermarket plastic bag (Jiji Tsushin, 2001). These taxes could give signals to consumers on their shopping behaviour.

Regulatory-5: Tighten and rationalise products energy efficiency

The government has introduced a top-runner system for product energy efficiency. Under the top-runner system, energy efficiency targets are established as the level being achieved by the most efficient products commercially available. The system,

however, has a disadvantage to recognise the *laissez-faire* levels as the highest standard. Also, some categories of the products do not have the top-runner targets. Tightening and rationalisation of the targets could stimulate product energy efficiency.

Regulatory-6: Introduce building energy efficiency standard

There are energy efficiency standards for buildings, but the appropriateness of the level of standards is in question (Mizutani, 2000). Also, the standards are of indicative nature, and they are not integrated into the formal building code (the Basic Building Act). Introducing tighter building energy efficiency standards has great potential to reduce the energy requirement.

Regulatory-7: Penalty for non-efficiency

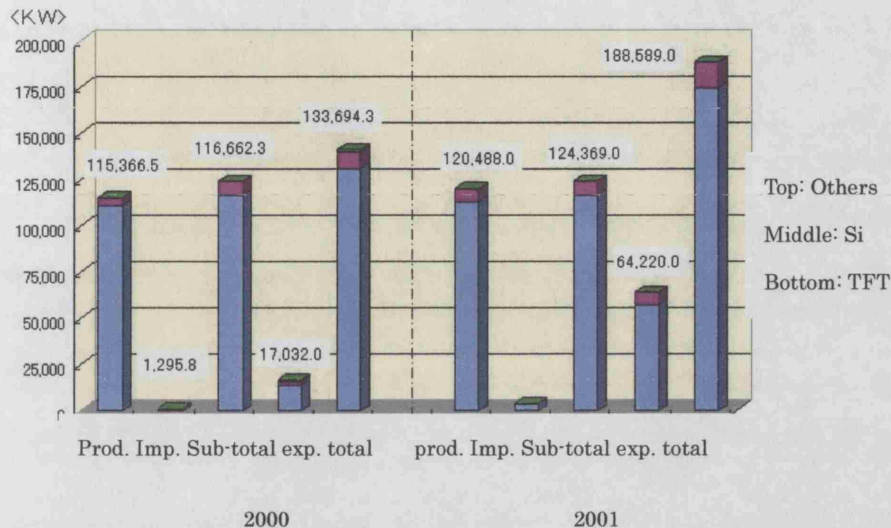
The 1998 Amendment to the Law Concerning the Rational Use of Energy (Energy Efficiency Law) requires manufacturers to comply with a certain energy efficiency standards for their product. The standards, however, are of aspirational nature, and are not accompanied by any penalty. This significantly dilutes the effect of the standards. To make the standards legally binding and to stipulate a penalty for non-compliance can enhance the chance of efficiency improvement.

Regulation-8: Coal Gasification

The Japan's energy production is largely relying on thermal powers, with a high percentage of coal. Currently this contributes to the increase of CO₂ emissions. Coal gasification technology, which can enable low emission of CO₂ and other pollutants, may bring justification to coal utilisation. It may be effective to impose regulation to restrict thermal use of coal only when coal gasification is applied.

Regulatory-9: Renewable Requirement on new buildings

The government has various subsidy schemes to support renewable application to domestic buildings. Even though the number of domestic buildings equipped with renewable facilities is increasing, their share is still fairly limited. For example, domestic solar power module production has been increasing, but the significant part of products is exported to outside of Japan (Table 5.5). The option is to have legal requirement for domestic buildings to adopt renewable application.

Table 5. 4: Solar power (cells and modules) production, export and import

(Source: Japan Photovoltaic Energy Association, homepage)

Regulatory-10: Limit Electricity Production

The Japanese electrification rate has gradually increased over decades. The electricity is, however, financially and physically the most expensive form of energy. The option challenges the experts on the idea to restrict electricity production, as this option may give signals to the market the need for electricity demand management.

Land-use-2: Change the overall framework of transport policy

This is to change the overall framework for transport policy from the current "predict and provide" attitude to "predict and prevent" paradigm. As shown on

Table 5.6, Japan has about 6,400 km of motorways. It may look relatively modest compared to the other OECD countries' level, but the data only includes high-speed motorway, excluding the other types of key roads (e.g. national roads in Japan with over 53,000 km extension. National road is equivalent to highway in the UK). Therefore, the level of Japanese road supply quite matches the level of other developed countries. Also, the experiences of the other OECD countries have demonstrated that the transport demand may be stimulated by the availability of roads. This option is to shift the overall aims of the transport policy from the physical connection of goods and people, towards management and reorganisation of transport logistics.

Table 5. 5: Motorway extension by country

	USA	Germany	UK	France	Italy	Japan
Motorway Extension (km)	73,271	11,143	3,141	9,000	6,401	6,453
Motorway Extension/capita (km/10,000 capita)	2.83	1.37	0.56	1.56	1.11	0.51
Motorway Extension/car (km/10,000 car)	3.78	2.64	1.38	3.01	2.05	0.94
Motorway Extension/area (km/km ²)	75	312	137	163	209	171

(Data for US, Germany, France in 1994, UK in 1993, Italy in 1991, Japan in 1999)

(Source: MLIT, homepage)

Land-use3: Lorry Sharing Scheme

Commercial fleet transport has been inefficient in a sense that transport companies often fail to recognise their fleet redundancy. For example, there are many fleets travelling back empty after they delivered goods. Against this background, an experiment has started in Fukuoka City, the southwest part of Japan, where commercial fleet companies and local banks established a transport company which uses shared vehicles for their goods delivery. They established information system as to their fleet availability, so that they can share the other company's fleets whenever empty. The wider application of the scheme should be started for further efficiency⁹.

Land-use-4: Combination of land use planning and transport demand management

As mentioned in Land-use-2 description, the Japanese transport and planning schemes have yet to fully recognise transport demand reduction as its top priority. The land-use planning has a great potential for transport management through, e.g. controlling the size of city, arranging the location of businesses so that people's needs are satisfied at local level. These all could contribute to management of

⁹ The Japan Track Association has identified the feet sharing as one of the actions to be taken by the industry (Japan Track Association, 2001).

transport demand.

Land-use-5: To reduce personal transport in the metropolitan area

Although metropolitan areas have had less traffic increase compared to suburban areas, they regularly suffer from congestion, resulting in energy inefficiency and pollution problems. Utilisation of public transport has great potential in the metropolis as those areas have high demand level for transport. There are, for example, some cities in Japan which have underground railways or maintain metropolitan tram systems. Extension of these existing systems, as well as construction of new schemes, would contribute to transport demand management in the metropolitan areas.

Land-use-6: To improve quality of public transport

The public transport in the whole modal share in Japan (especially in metropolitan area) is relatively high among other OECD countries. For example, a research revealed the Tokyo's public transport share is maintained as about 28%, which closely follows Rome (32%) and Paris (30%) in the beginning of 1990s (Murakami, 2000). The reality behind the high usage of public transport is, for example, the overcrowded commuting train which is tolerated by the Japanese passengers' patience. Although the over-crowdedness is gradually decreasing, if

the situation continues, the higher public transport reliance may be undermined.

The Japanese public transport should pay attention to improve the quality (as well as the quantity) of passenger travel to maintain its level of current customer volume. Continental European commuting trains, for example, increase their capacity by introduction of double decked carriage. These European practices may provide a hint to the Japanese trains' quality and quantity improvement.

Land-use 7: Inter-port logistics

Currently, many ships use the major three ports (Tokyo, Kobe, Fukuoka). These ports are, however, not necessarily the nearest to the final destination of their freight. As a result, road transport is additionally required to carry the goods. Re-organisation of port logistic and necessary local port enlargement can contribute to the fleet transport demand reduction.

Land use 8: Support for fleet railway

The modal share of railway transport is less than 4% in 2000 for goods delivery, whereas commercial fleet is increasingly relying on road transport. Privatisation of the railway systems in Japan, which took place in 1980s, is also behind the context for the closure of many financially unattractive railway routes. To place the railway transport at the core of goods transport may contribute to the

revitalisation of public transport. For example, the JR-Kamotsu, a Japanese railway company specialised in freight transport, is marketing its services with energy efficiency appeal. It is claiming that it helped many companies to achieve CO2 emission reductions through its services (JR-Kamotsu home page).

Land use—9: Parking space regulation

Providing parking spaces for customers has been one of the planning requirements for large-scale commercial development, encouraging more people to rely on road transport. Also there are little planning constraints to convert residential areas into parking sites. Reviewing these planning inadequacies through stipulating disincentives for parking space could give signals for less dependency on private transport.

Land use-10: Renewable Restriction

There are currently many land use regulatory restrictions being the barrier to the mass deployment of renewable energy. For example, wind power installation is not allowed in the national parks. Relaxing some of these restrictions may encourage renewable development.

Cross sectional-1: Recycled materials

This option is to encourage material recycle of industrial and domestic waste.

Researches have demonstrated that production of raw materials through recycling results in less CO₂ emission, than production of the raw materials from virgin materials. (Mizutani, 2000).

Cross sectional-2: Biomass waste

It is to encourage biomass waste power production. Currently, there is much biomass waste simply being incinerated. The waste management strategy needs to be reorganised so that the biomass waste can be used for power production.

Cross sectional-3: Reduce petrochemical products

There have been many cases where petrochemical products' recycle rate is going up. The improvement on recycle rate is, however, not linked to the reduction of material imports. For example, the extent to which petrochemical raw material is imported remains unaffected by the increase of recycle rate. In order to reduce the use of petrochemical raw material, there is clearly a need to introduce more radical steps.

Cross sectional-4: Energy Crops Production

Until recently, biomass energy in Japan was not widely recognised, with energy crop production has received little attention. The reason behind this is that meaning of biomass in terms of CO₂ management is not well understood, and there is a perception that energy crop production may require drastic change in land use. Innovative use of land (e.g. using obsolete rice fields) under strong local initiative could be a key to the development of energy crop production.

Social option-1: To encourage green procurement of the national/local government

In April 2001, the government green procurement legislation is implemented, which requires the national and local governments to purchase “green” products. The law, however, does not cover renewable electricity. The expanding the scope of legislation to cover renewable electricity would boost the demand.

Social-2: Change the way in which national energy forecast is drawn

In July 2001, a new energy forecast has been made, but the government manipulation was evident, with little reflection from public inputs. Such undemocratic way of setting national energy strategy is as a matter of urgent reform.

Social-3: Political decentralisation

The central government of Japan maintains the powers inherited from the pre-war systems¹⁰. The energy issues are the cores of the central governance, with little reflection of the local considerations. Recently, the decentralisation initiatives were carried out, with amendment to the Local Government Act in 2000 as the vindication of the long struggle to local autonomy. The centralised control is, however, still influencing significantly over the local decisions, especially on the issues related to energy supply structure and power plant siting choices. The centralised control places the significance over the energy supply and price security. As a result, local planning and decisions were undermined. Giving more powers to local authority can enhance the local autonomy, which may be the prerequisite for local energy management.

Social-4: Local Energy Plan

Energy plan can be developed at the local level. There is a financial support scheme provided by the NEDO under which local governments are required to draw up local energy plans. They are expected to propose the innovative

¹⁰ The post war US intention to break up the pre-war Japanese systems was later reversed to preserve them, in order to define Japan as an anti-communism base.

application of renewable and waste energies, and then the NEDO is supposed to give subsidy to implement some of the ideas. However, only a few of the local authorities have joined the initiatives, which means only a limited number of local authorities have the resource and capability to draw its energy plan. Nevertheless, the energy demand and supply strategy at local level would be highly important to achieve sustainable energy targets at the national level.

Social-5: independent institution for energy efficiency

This option is to establish an independent institution which advises and monitors energy service companies (ESCO). The ESCO business has started in Japan with rather slow uptake, though there are a various organisations claim their expertise in the business. Behind this is little recognition as to what benefit ESCO brings. Also, credibility of such organisations is yet to be established. An independent institution for energy efficiency to accredit ESCO consultants may help their recognition and credibility .

Social-6: Create employment demand

It is to create employment demand through renewable and energy efficiency development. Job creation can ensure the preparedness of the public to accept renewable development. Denmark, for example, is successful in developing new

jobs through wind turbine industry.

Social-7: Reduce public spending

Since the burst of the "bubble economy", the government has poured public money to a various spending programmes. The total amount of the public spending amount to ¥ 430 trillions (US\$ 4.1 trillion) from 1991 to 2000. The massive public spending programmes were originally started by the Japan-US agreement during 1990s that Japan to reduce its gross domestic profit. The main purpose of the investment is now to sustain vulnerable industries, such as construction and manufacturing, and to keep the level of employment. Also it serves to gain voter's support the particular political parties. From energy and environmental perspectives, the public spending was much criticised on the ground that it increases the demand for raw materials. Recently, the government overall economic policy emphasis was turned to structural shift under the Koizumi cabinet. Nevertheless, assessment of the public spending programmes is urgently required.

5.2.4.2 Experts' Verdict

There are many options highly evaluated by the experts. Those include the

following:

To prepare heat strategy (Supply-10), Biomass Electricity (Supply-11), Give priority to renewable electricity (Infrastructure-3), Development of green electricity certificate trade (Market-8), Feed-in tariff (Supply-8), Reallocate petroleum account (Financial-3), Restructure tax for passenger vehicles (Financial-10), Tightening of fuel efficiency standards (Regulatory-4), Change the overall framework of transport policy (Land-use-2), Vehicle Sharing Scheme (Land-use-3), Combination of land use planning and transport demand management (Land-use-4), To reduce personal transport in the metropolitan area (Land-use-5), Recycled materials (Cross sectional-1), To encourage biomass waste power production (Cross sectional-2), Green procurement (Social-1), Change the way in which national energy forecast is drawn (Social-2)

The option of Supply-10 to prepare heat strategy was highly evaluated by the experts, reflecting the expectation and sense of urgency attached to the heat management. Also Supply-11: Biomass Electricity gets high scores for its priority. On the other hand, there are views that biomass waste power production may not be cost effective, as there may not be sufficient biomass available in Japan.

As is in the Vision III, Infrastructure-3 (Give priority to renewable electricity for grid connection) was regarded as an important step for achieving the Vision IV. The technical aspects of grid capacity were also pointed out: Modifying the system specifications of the existing electricity grid would be the prerequisite for the option.

The option of Financial-10: Restructure taxes for passenger vehicles was highly valued by the experts. On the other hand, there is a view that the international pressure made this option unfeasible: The trade pressure from the countries, namely the US, could work against the restructuring of the vehicle taxes.

Land-use 2: Change the overall framework of transport policy was also highly evaluated. There is a view that the modal shift should be encouraged under the new transport policy.

Though green procurement of the national/local government (Social-1) has already been a government policy, there is a view that it should be expanded more, especially at the local government level.

The above were followed by these options: Give subsidies to the renewable

electricity generation (Supply-9), Liberalisation of energy production (Market-10), Combine green electricity certificate and CO2 permits trade (Market-11), Product efficiency (Regulatory-5), Introduce building energy efficiency standard (Regulatory-6), to improve quality of public transport (Land-use-6), Political decentralisation upon energy policy (Social-3), (Social-4), independent institution for energy efficiency (Social-5), Create employment demand (Social-6) Reduce public spending (Social-7).

Relatively modest evaluation was given to the Subsidy option for the renewable electricity instalment (Supply-12). This is because cost-effectiveness of providing subsidy for capacity increase is questioned.

There were mixed views towards the Liberalisation of energy production (Market-10). Some views were provided by experts that liberalisation of the market could induce a short-sighted decision to adopt cheaper electricity fuels, thus what fuel will be dominant under the liberalised market will be crucial to decide the effectiveness and priority of the option.

There is a rather logical response to Combine green electricity certificate and CO2 permits trade (Market-11) that the combination of CO2 permits and green

certificate can be carried out after those systems are fully developed domestically.

Nevertheless, the Market-11 was viewed as stimulus by some of the experts.

The option to Introduce building energy efficiency standards (Regulatory-6) was not received positively by some of the experts: Giving economic incentives was preferred to imposing regulations to improve building energy efficiency.

Some experts recognise the Political decentralisation (Social-3) and the To oblige local authority to establish local energy/transport plan (Social-4) were not considered as "effective" options, but as "necessary" policies, as these form basis for the identification of local energy needs and formulation of a sustainable local energy strategy.

It is the similar case with the Social-6: Create employment demand: Although this might not be effective for CO2 reduction, the option was regarded as necessary to give the society a picture of the future possibility.

On the Social-7: Reduce public spending, some experts commented that the effectiveness and priority of this option depends on how the unnecessary public spending is defined.

Less appreciated options include: Develop electricity storage system (Infrastructure-8), Allow more customers to negotiate directly with electricity suppliers (Market-12), On-site energy de-regulation (Market-13), To support on-site energy production (Financial-9), Virgin material tax (Financial-11), Penalty for non-efficiency (Regulatory-7), Coal Gasification (Regulation-8), Renewable Requirement on new buildings (Regulatory-9), Inter-port logistics (Land-use 7), Support for fleet railway (Land-use 8), parking spaces regulation (Land-use-9), Reduce petro-chemical products (Cross sectional 3), Energy Crops Production (Cross sectional 4).

The Market-12 option to allow more customers to negotiate directly with electricity suppliers was perceived with mixed opinions. There is not much expectation for the electricity market liberalisation to contribute to the CO₂ emission reduction, as the experience in Japan demonstrated that the liberalisation induced the generators' decision to use as cheap fuel as possible. There was no mention by the experts about how market liberalisation can stimulate the green energy market.

The On-site energy de-regulation (Market-13) did not get a unanimous verdict.

The reason for this seems to lie in the experts' comments that the effectiveness and priority of this option depend on which fuel will be used. Financial-9 to financially support on-site energy production and consumption also received mixed views.

There was an opinion that, if the virgin material tax (Financial-11) is applied to all the imported raw materials, the price of many products would raise sharply, creating devastating damage to domestic manufacturing industry.

For the Penalty for non-efficiency (Regulatory-7), there is a view that information should be disclosed first on energy efficiency non-compliance, before any penalty is given.

Coal gasification is expected to be available in the market around 2020. Due to this, immediate regulation to require coal gasification (Regulation-8) was regarded as premature as an immediate action. This option should remain as a long-term option.

Although the option to legally require renewable equipment on new buildings (Regulatory-9) was perceived well by some of the experts, there was also a strong

view against the regulatory approach to solve the problems.

Although the Reduction of petro-chemical products (Cross sectional 3) did not receive high effectiveness scores, an expert suggested that this option could be possible if, for example, more biomass products become more available to replace petro-chemical products demand.

Little appreciated options were: Infrastructure-9: reduce high voltage transmission

Infrastructure-10: Tele-commuting, Market-14: Gas-Direct negotiation, Regulatory-10: Limit Electricity Production

Reduction of high-voltage electricity transmission (Infrastructure-9) is thought to be unrealistic, and damaging to the consistent supply of electricity. It was received poorly by most of the experts. There is, however, no mention by the experts on the health and environmental impacts of the high voltage transmission.

There are few experts who consider encouragement of tele-commuting (Infrastructure-10) as an effective option. The reason for this seems to be that wider availability of tele-commuting could also stimulate direct communication,

increasing the need of physical transportation of people and goods.

Restriction of electricity production (Regulatory-10) received few scores. Several experts commented that demand management should get priority than the simple solution such as this to restrict electricity production.

Figure 5. 10 Policy evaluation for Vision IV

(Supply)				
increase mini-hydro (54)		abolition of nuke (30)		
(Market)				
CO2 permit trade (50)	electricity price menu (47)			
(Financial)				
reallocate EPRDSA (54)	coal tax (46)			
(Regulation)				
	CO2 in EIA (43)	limit IPP's fuel choice (37)		limit IPP's market entrance (13)
(Information)				
	PRTR (47)			
	product labeling (46)			

(Supply)				
heat strategy (57)	fuel cell for transport (42)	renewable & gas as baseload (35)		
biomass electricity (56)	subsidies to renewable (43)			
Feed-in tariff (54)				
(Infrastructure)				
renewable grid connection(51)	develop pipeline (41)	electricity storage (39)	reduce high voltage (23)	
	increase of CHP (49)		tele-commuting (23)	
(Market)				
green electricity trade (61)	liberalise energy production (45)	horizontal split electricity industry (32)	gas direct negotiation (29)	
	Green electricity & CO2 permit(43)	electricity direct negotiation(33)		
		on-site energy (30)		
(Financial)				
allocate petroleum account(58)	carbon tax (48)	subsidy for on-site energy (37)		
general budget (56)		virgin material tax (31)		
tax for passenger car (54)				
(Regulatory)				
Fuel efficiency standards(53)	product efficient standard (46)	penalty for non-efficiency(39)		limit electricity production (18)
	efficient buildings (43)	coal gasification (34)		
		renewable on new buildings(33)		
(Land-use)				
revise regulations (52)	quality of public transport (45)	inter-port logistics (39)		
transport policy (58)		support fleet railway (38)		
lorry-sharing (55)		parking space		

		regulations (31)		
reduce transport demand (52)				
metropolitan public transport (52)				
revise regulation for RES development (52)				
(Cross-sectional)				
use recycled materials (52)		reduce petro-chemical products (33)		
biomass-waste power (50)		energy crops production (31)		
(Social)				
government green procurement (59)	political decentralization (47)			
national energy forecast (57)	local energy plan (45)			
	independent institution (45)			
	new employment demand (44)			
	reduce public investment (43)			

5.3 Concluding Remarks

This chapter illustrated the policy options and packages under the four Visions. Appendix E summarises the package structures: The Vision I options are limited, but common to all other policy packages, the Vision II package is mainly concerned with the greater use of gas, the Vision III package relates to development of renewable energy sources, and the Vision IV package covers the demand management measures, as well as other technical solutions.

In this Chapter, the priority and effectiveness evaluation by the selected energy experts were presented. In Chapter 6, the policy paths will be demonstrated as the “road maps”, with the experts’ inputs serve as the key information to assemble them. The road map construction will follow the analysis from the perspective of their appropriateness as policy package to achieve the particular future Visions.

Chapter 6: POLICY PACKAGES AND IMPLEMENTATION ANALYSIS

6.1 Introduction

The previous chapter introduced the policy packages and the first validation process. During this process, priority and effectiveness of each policy option were identified, so that their positioning in the policy packages is identified.

This chapter combines the policy options to formulate the policy paths (the “road map”) to achieve each Vision. The options were categorised as “immediate steps” and “intermediate and long-term steps”, based on the scores they gain. Policy options are linked to describe their sequence to constitute each policy path (the Road Map).

A particular emphasis is given to some policy options, in order to reflect the effectiveness attached to them. Also, an intuitive judgement is made to show strength and duration of phases required, because some options may need adaptation periods before their full effects are realised, while others may need to be phased out as their chief role gradually diminishes (e.g. financial subsidy for a

particular technology may not be required after that technology become accessible in a market).

The policy paths will be followed by the implementation analysis, in which the feasibility of the paths will be analysed from the perspectives of resource implication, barriers to change, responsibility for change and the achievement of targets.

6.2 Policy Package for Vision I (“Business-as-usual”)

6.2.1 Description of Policy Path

The essential element of the Vision I is conservatism. Thus only minimum policy change is advocated under this Vision. The policy options identified, however, are those which are also required for other Visions (For example, the “reallocation of EPRDSA is also the critical element of Visions II, III and IV). In other words, highly selected options which are robust under different Visions are grouped in the Vision I policy package.

6.2.2 Immediate and Intermediate Steps

An immediate step for the Vision I is to reallocate EPRDSA, which has been long debated by the critics. The fund should be arranged to finance energy efficiency and renewable energy. Another step is Domestic CO₂ permit trade. Intermediate steps for the Vision I include 1) increase of mini-hydro power station, 2) information dissemination through PRTR, and 3) product CO₂ labelling, through which consumers are able to determine the environmental attribute of the manufactured items (Figure 6.1).

6.2.3 Resource Implications

The Vision I road map is supposed to require minimum resources for its implementation. For example, electricity price menu change can be discussed in line with the ongoing market liberalisation. That is because once the market is liberalised in a way that utilities can more freely decide the level of electricity price they charge on customers, the peak time electricity price is likely to be raised. It would have the same effect as price menu change through regulatory intervention. Since the further market liberalisation is scheduled, the option, or more precisely, the effect of option may be achieved as the process goes, no

matter if the option itself is introduced or not, thus decreasing the implementation barriers.

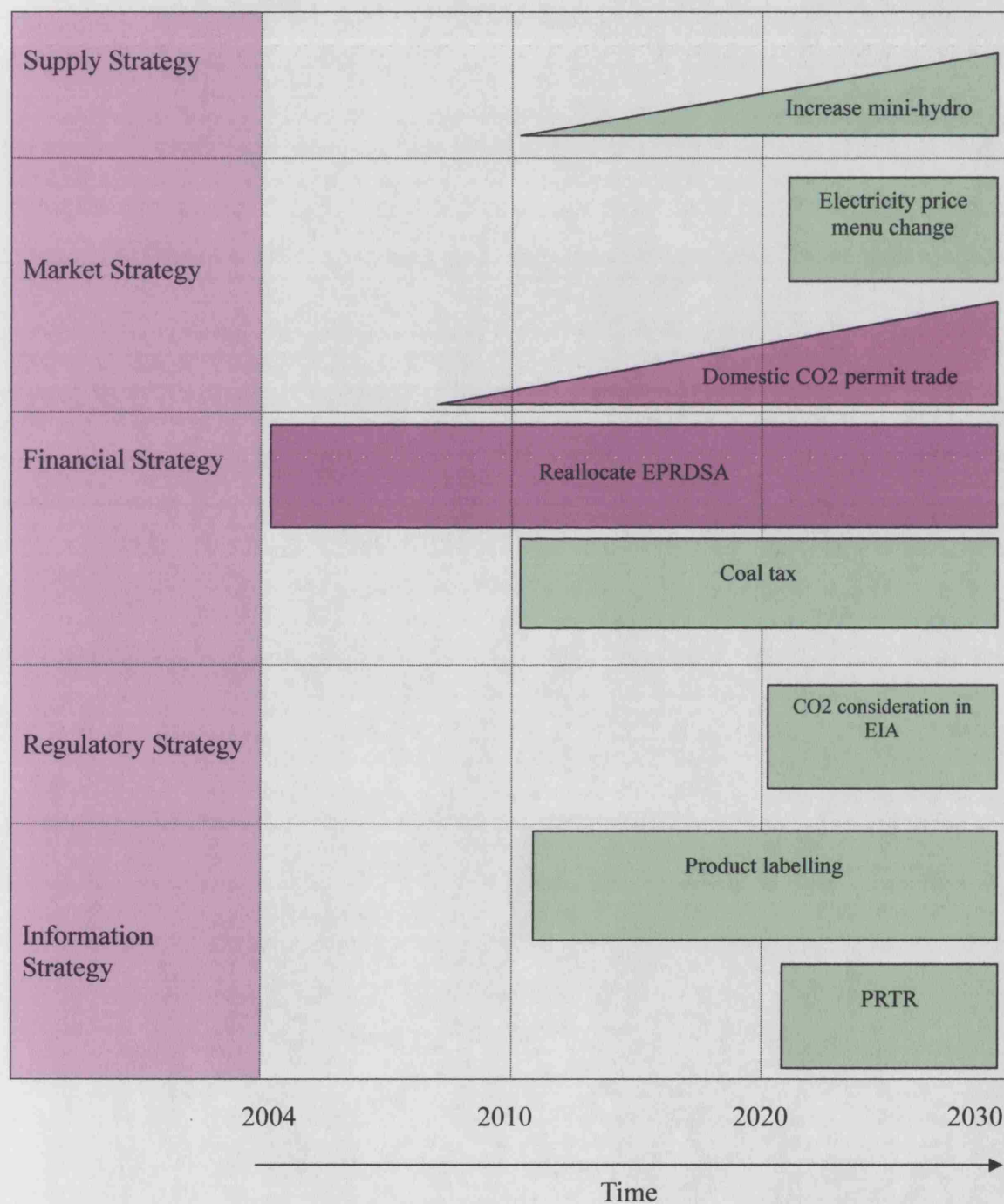
6.2.4 Discussion on Vision I Policy Path

As the Vision I involves limited number of policy options, the phasing of them can be relatively simpler than in the other Visions. Also, the costs associated with the Vision are limited, due also to the limited number, as well as individual nature and context, of the identified options (as in the case of electricity price menu change, discussed above).

This, however, does not mean the option implementation is easily carried out without uncertainty. For example, the domestic CO₂ permit trade (identified option as a market strategy) requires nationwide industrial approval. Such a scheme would materialise only if an atmosphere of acceptance is created through political and economical compromises. In July 2004, MoE announced its intention to introduce voluntary CO₂ permit trade scheme in 2005, and it is going to launch a sister system to subsidise industry to adopt energy efficiency technology, with which they are supposed to gain the CO₂ margin. In this way, MoE tries to smooth the way to establish the CO₂ trade programme, and this kind of combined

strategy may also be required for other options to be introduced.

Figure 6. 1: Road map for Vision I



6.3 Policy Package for Vision II (“Gas Japan”)

6.3.1 Description of Policy Path

The key to the Vision II is the supply of cheap gas. The construction of the international and domestic gas pipeline is the crucial element in achieving many Vision II policy options. In other words, many of the options in the Vision II will not be feasible, unless the pipeline is in place.

The construction of gas pipeline, therefore, should be initiated as soon as possible to achieve the Vision II targets. The tax and budget system restructuring is urgently needed to achieve this. However, due to a large financial resources required, the establishment of the pipeline should be identified as an intermediate, rather than an immediate step.

6.3.2. Immediate Steps

As immediate solutions, the combination of the core and individual options suggest that the current budget system requires an immediate restructuring. Also

as an urgent step, a technically viable supply change (e.g. the conversion of coal-fired power station to natural gas use) should be carried out (Figure 6.2).

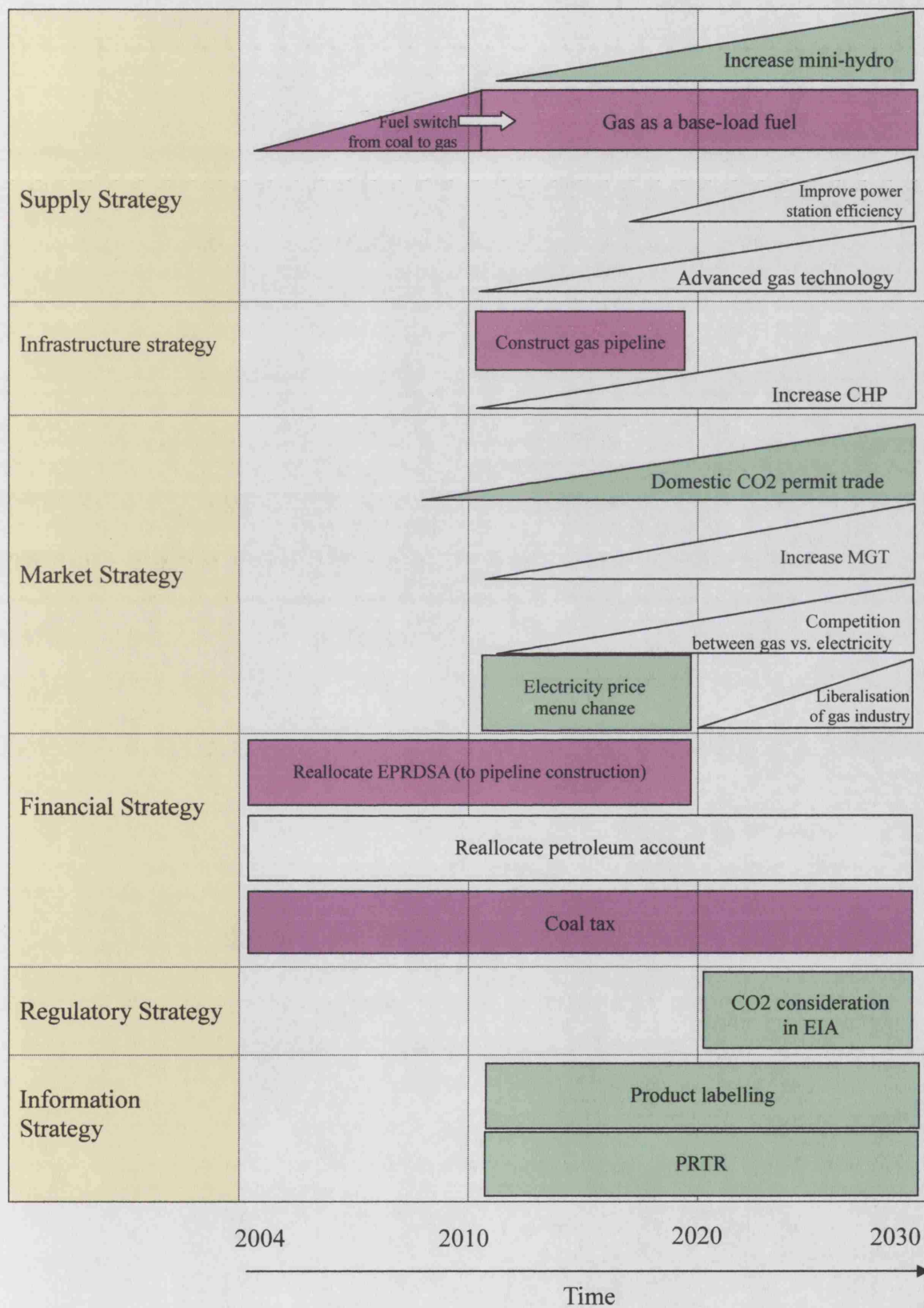
6.3.3 Intermediate and Long-term Steps

As an intermediate step, construction of international and domestic gas pipeline is very important. It should be initiated as soon as the financial backup becomes available from the re-allocation of the energy special budget and others (The international co-operation budget e.g. ODA should not be employed to finance the construction project.) The construction of pipeline and the introduction of coal tax, would together make gas more attractive than coal. They create a momentum to redefine gas as a baseload fuel. The gas pipeline construction should pave the way for other measures such as increase of CHP, advanced gas-fired power station technology such as CCGT, and wider use of micro-gas turbines (MGT) at home and work.

The competition between electricity and gas, which has started at the turn of the last century, will be further encouraged to benefit energy customers. The above measures should lead to the situation where the gas industry, with the cheap supply of natural gas, can compete on the level playing field with the electricity

industry.

Figure 6.2 : Road map for Vision II



6.3.4 Resource Implications

The Japanese government and industry have been interested in the gas pipeline construction. Private research organisations, such as Mitsubishi Research Institute (MRI), are carrying out feasibility studies on the issue. The MRI has proposed the construction of an open-access pipeline which allows the third party to operate gas wholesale business through it. According to the proposal, the 5,300 km long main pipeline is to connect the existing LNG bases. The proposed pipeline costs around ¥ 4 trillion (US\$ 36 billion). It would be about ¥ 9 trillion (US\$ 81 billion) if indirect costs were included. On the other hand, the pipeline is expected to reduce the consumer gas prices. The pipeline construction will also create jobs, which is estimated to secure employment for 580,000 workers (MRI, 2000).

The project will, however, not be financially viable, unless there is strong financial and political support. Planning de-regulation to ease the construction work is one example of the essential policy support. Also, stimulating gas demand through various policy measures could add to the financial attractiveness of the project¹.

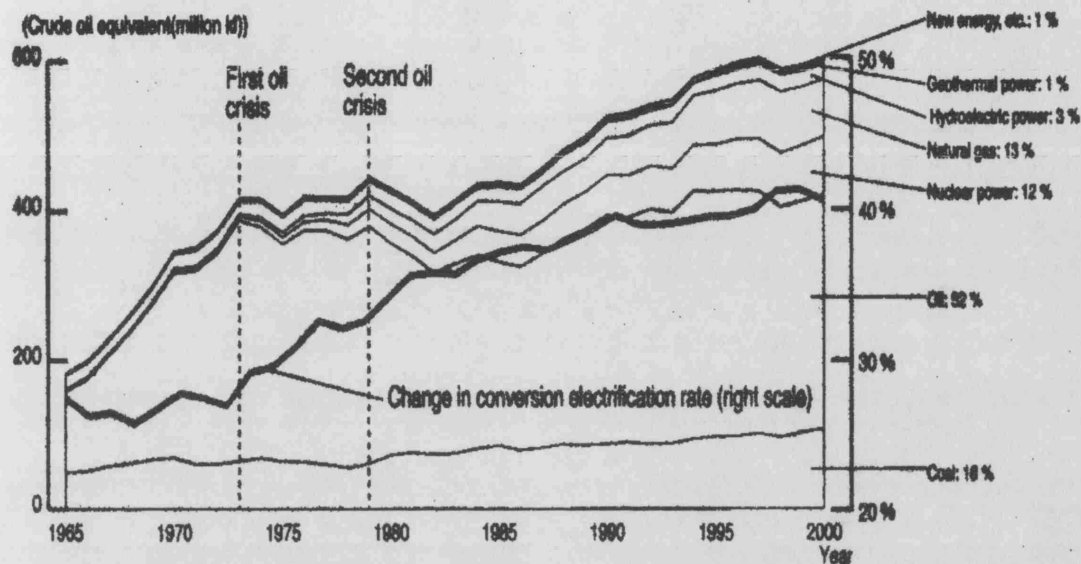
¹ Japan is in the process of installing optical fibre to enhance the speed of information

In terms of direct financial injection, the EPRDSA budget, which accounted for ¥ 450 billion (US\$ 4.1 billion) per year, can, at least partly, be allocated to the gas pipeline construction. (Care is required to avoid the problems usually associated with overspending of public money). Indirect assistance, such as tax exemption for the project investors, could also help finding sufficient capital, and should be considered as a supporting option.

In addition to the above mechanisms, establishing gas as a national strategic fuel is also a key issue. The General Energy Committee (Sougou Energy Chousa-kai), the advisory group to the Economy and Industry Minister, emphasised the importance of the fuel switch to gas (METI, 2001a). In fact, the natural gas share has been steadily increasing over recent decades (Figure 6.3), but if it is recognised as a national strategic fuel, the Vision II has a strong possibility of becoming a reality.

transmission. If optical fibre could be built in alongside with the pipeline, it would reduce the overall cost of both pipeline and optical fibre establishment. Further, it could allow the pipeline operator to enter the information business at the later stage to recover the cost of investment.

Figure 6. 3: Primary Energy Demand in Japan



(Source: ANRE, 2002)

6.3.5 Discussion on Vision II Policy Path

6.3.5.1 Phasing

MRI estimates a 1.5-7% reduction of CO₂ emission (depending on how much fuel switching takes place) is possible through the pipeline construction. The completion of the gas pipeline will take at least 4-5 years or more with the planning stage is counted. Yet there is little sign of a decision to construct an extensive domestic gas pipeline. It would, therefore, be difficult for Japan to

anticipate a fuel switch to natural gas becoming the single major element to achieve CO₂ reduction target for the first implementation period under the Kyoto Protocol.

The fuel switch to gas will, however, enable Japan to achieve certain CO₂ reductions and provide a solid infrastructure for the new generation of fuels. The same pipeline, for example, can be used to distribute hydrogen. This longer term perspective to utilise gas pipeline to supply hydrogen is particularly important given the recognition that the natural gas is a finite resource, though it has larger deposits than other fossil resources.

It is highly difficult to estimate most effective phasing of options. Nevertheless, the conceptual possibility is broadly described as in Figure 6.2.

6.3.5.2 Cost

The overall cost associated with the Vision is high, because the large-scale infrastructure construction is required as a core part of the package. On the other hand, the construction of the gas pipeline may also be placed in a political context, as a cause to give a vital injection desperately demanded by construction

companies, who have suffered devastating damage after the “Bubble Economy”, the Japan’s speculative boom during 1980s, that burst in 1990s. In this case, the cost of the pipeline should be examined from the socio-political context, rather than the pure environmental perspective.

6.3.5.3 Uncertainty

There are many uncertainties related to the Vision II package. The first of which is the willingness of the utilities and government to support the fossil fuel switch and the pipeline construction. Their prevailing unwillingness is due mainly to financial considerations, but also other constraints, such as international politics.

On September 18, 2002, for example, Japan entered a negotiation with North Korea. This was strongly prompted by international communities, especially those who have particular interests in “opening up” North Korea. Russia has a plan for connecting Caucasian natural gas through the Korean peninsula to the international market. North Korean cooperation with Russia is crucial for this plan.

The Russian ambition and the fate of the gas pipeline became highly uncertain

when Japan and North Korean relationship soured due to the issues of North Korea's nuclear intentions and the kidnapping of Japanese citizens. Their future political relationship thus adds uncertainty over international energy sales and delivery.

The uncertainties also relates to the environmental concern. Critics strongly argue that the international pipeline, including LNG development in Sakhalin, damages agriculture and fishery production. The costs, international politics and the environmental concern associated with the pipeline development may indicate the risks of the Vision II are higher than those of other Visions.

6.4 Policy package for Vision III ("Renewable Emergence")

6.4.1 Description of Policy Path

The key to the achievement of Vision III is whether and how soon the feed-in tariff can be introduced as a national policy. The experiences in Germany, Denmark and Spain suggest the feed-in tariff can boost the renewable generation: the German renewable capacity increased during 1996 to 2001 by 200%, Denmark 200% and Spain nearly 600%. Many argue the feed-in tariff system is

the driving force behind these significant capacity expansions (Meyer, 2003, Krewitt and Nitsch, 2003). When applied, the feed-in tariff may dramatically increase Japanese renewable electricity production, which is currently playing only a marginal role in energy supply structure.

This option should be carried out in co-ordination with the other options, such as tax restructuring, endowing grid access priority to renewable electricity and the revision of planning regulations. Other important issues are the introduction of carbon tax and a domestic CO₂ emission permit trade.

6.4.2 Immediate Steps

The feed-in-tariff can ensure a favourable investment environment for renewable electricity producers, and it could lead to a dramatic increase of renewable energy generation. This option should be combined with another option such as Financial-1 from the core category, to allocate EPRDSA². By combining the

² This argument has been made by the Green Electricity Network (GEN), a Japanese non-governmental sustainable energy group to raise necessary financial resource for the utilities to purchase renewable electricity: they argue, in this way that society can share the cost of renewable paying extra to develop fossil-alternative fuels, as in fact that is the purpose of EPRDSA.

Feed-in tariff and the re-allocation of EPRDSA, it is possible to raise necessary financial resources for the utilities to purchase renewable electricity. Also in this way, the society can share the cost of renewable development without paying extra tax (Iida, 1999).

The need for giving tax exemption to those who participate to the green electricity certificate scheme should also be identified as an immediate action. It can help increase the demand for renewable electricity. Joining into the international green certificate trading should be kept in mind for the development of the domestic green certificate scheme.

Another urgent action identified is to give grid access priority to renewable electricity. This option, however, requires some technical improvement be made, as a precondition to its implementation. Improvement of grid capacity, for example, is seen as a necessary step for larger deployment of renewable electricity, and the re-allocation of the existing financial resources, such as the energy-related general budget, should be carried out to finance it. (The grid improvement option was added into the Vision III road map, though it was not covered by the first round questionnaire.)

In order to improve the renewable grid access, the EU Renewable Directive, for

example, obliges the grid operators to publish technical specifications and requirements. The similar practice can also be effective in the Japanese context to enhance the transparency as to grid accessibility.

The imposition of a carbon tax is another option with high priority rates attached by the experts. The tax should be incremental to the carbon-intensity of fuel types. It should also be high enough to give impetus to fuel switch. The budget raised through the tax should be allocated to the renewable and energy efficiency causes. The coal tax could be integrated into this option.

The revision of fuel efficiency standards should be started. The regulation for the conventional fossil-fuel vehicle efficiency standard should be tightened to reduce the gap between the standards and levels that the latest technology can achieve.

In the meantime, obstacles to renewable development, including the land-use regulations, should be reviewed so that necessary actions are taken. A care must be paid so that the renewable cause does not violate democratic process in the land-use planning (Figure 6.4).

6.4.3 Intermediate and Long-term Steps

After ensuring the feed-in tariffs to stimulate renewable power generation, the policy option can gradually shift to a more sophisticated system based on market mechanisms. The feed-in tariff may make large-scale renewable development, such as offshore wind farms, financially feasible. The RPS can then replace the feed-in tariffs as the renewable electricity market becomes mature as the scale economy operates. By taking this two-step action, the less commercially advantageous renewable energy (e.g. solar power) can be developed until there is sufficient price reduction, which enables the competition with their cheaper rivals (e.g. waste combustion power).

Intermediate steps also cover the development of fuel cells and the necessary support for its application. It is believed that fuel cell driven vehicles will be commonly available by 2030. But given the rapid development of technology, if helped by crucial infrastructure, a much earlier uptake may be possible. Also, domestic fuel cell power and heat generation is believed to have a great potential. Some industries are keen to exploit this market, and working on the schedule to make the domestic fuel cell facility publicly accessible by 2005 (Mainichi, 2003). For the moment, however, hybrid vehicles are seen as a “bridge” technology

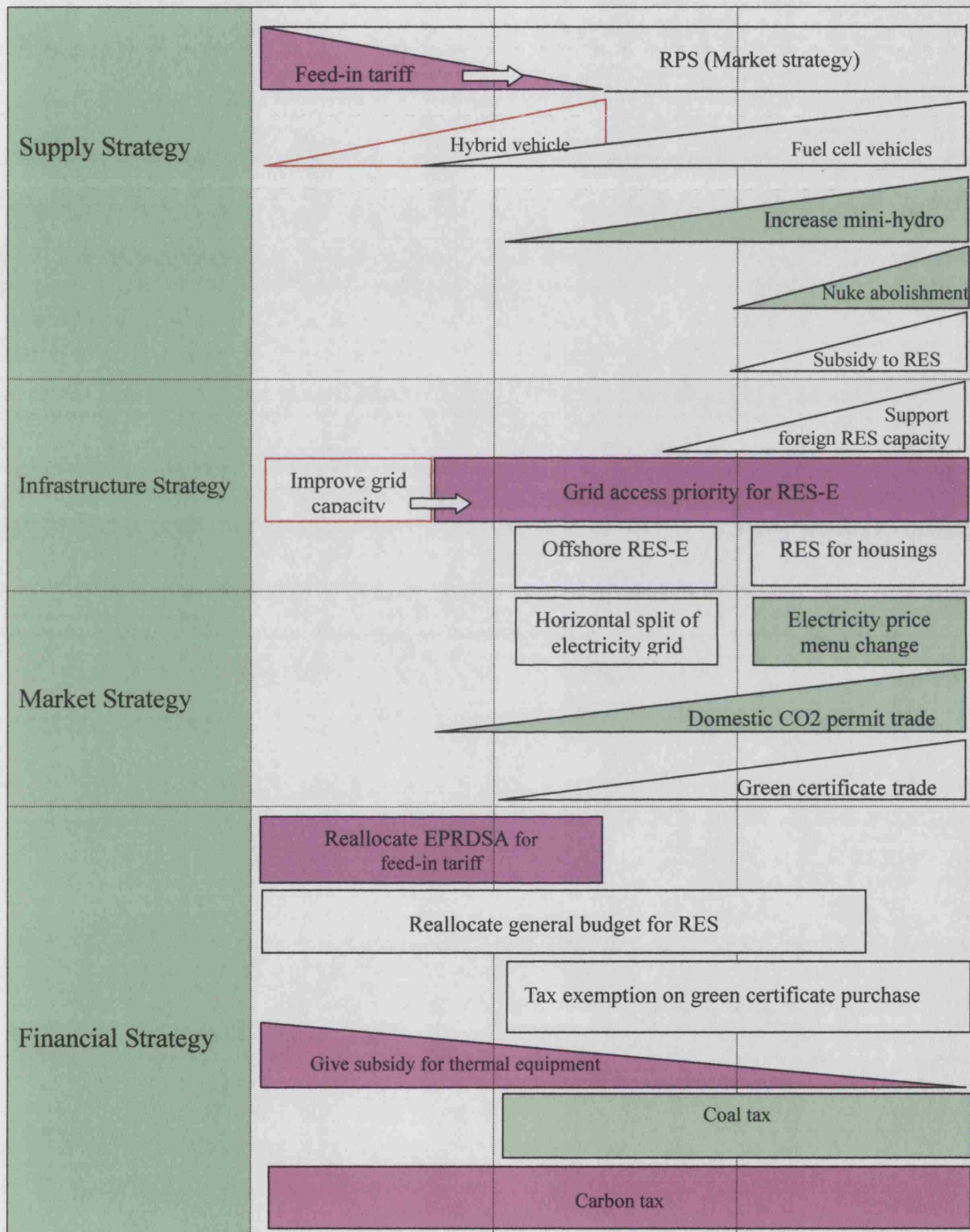
between the existing and the future (fuel cells) technologies, thus the larger deployment of hybrid vehicles is newly identified as one option in the Vision III road map.

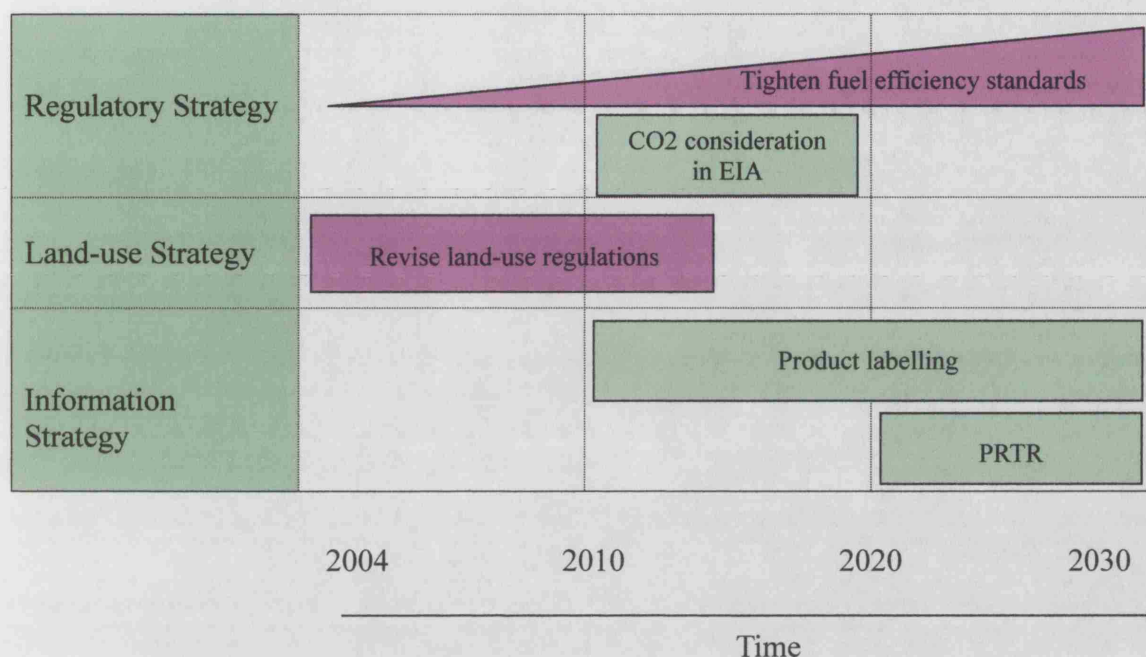
The horizontal split of electricity industry and the creation of a grid company is another important intermediate action. It could greatly contribute to the opening up of the electricity market, allowing decentralised power producers, including renewable electricity generators, to stand on a level playing field with the existing players.

Supporting foreign countries renewable production can contribute to the overall reduction of CO₂ emissions, and it should be encouraged as part of Japan's foreign diplomacy. Systems such as the Kyoto mechanisms can justify the Japanese sustainable energy co-operation with other countries. At the same time, care must be taken so that the donor country's preference does not dominate the recipient country's fuel choice. For example, biomass can be the cheapest available fuel in some countries, whereas the donor country may prefer them to adopt much more expensive technology (such as solar power) which can easily turn out to be financial burden on the recipient country.

Renewable energy production for domestic buildings should be encouraged through market incentives, rather than the imposition of regulations. The experience has shown that subsidies to renewable and thermal equipment contributed to the capacity increase, and they should continue.

Figure 6. 4: Road map for Vision III





6.4.4 Resource Implications

The EPRDSA amount to ¥500 billion (US\$ 4.5 billion) annually. In 1998, however, only ¥336.5 billion (US\$ 3 billion) out of the total ¥ 500 billion (US\$ 4.5 billion) EPRDSA was spent, and some of the EPRDSA is deferred. The deferring of the budget has resulted in the accumulation of funds (JACSES, 2000)³. The re-allocation of the Account would be thus sufficient to finance the cost of the Feed-in tariff. For the implementation of the Feed-in tariff, it is estimated that ¥ 2-3 billion (US\$ 18-27 million) is required (Iida, 1999).

³ In 2000, nuclear development law was enacted: there is an alleged view that the purpose of the law is to find excuses to consume the budget, so that necessary funds for feed-in tariff are eroded.

It is not yet known how much financial resource is necessary for the upgrading of electricity grid infrastructure in Japan. Research on the technical and financial requirements for the grid improvement is urgently needed, as well as action to make the grid operators publish their grid information.

There are some financial support schemes for solar heat equipment, but whether those supporting schemes are sufficient to achieve the target is not clear⁴. For solar heat, there was a loan scheme operated for 16 years (1980 to 1996) to contribute to the increase of its capacity. The annual budget for the loan varies each year, but on average ¥10 million (US\$ 90,000) was sufficient to increase the take up of the solar heat system for the 270,000 households, half the total number of households which purchased the system over the same period. The government target for the solar heat introduction by 2010 is 4.5 million kloe, about 5 times more than the 2000 level. If it assumed that at least 5 times more than the average loan budget, ¥ 50 million (US\$ 450,000) is required. This is a negligible amount from the national budget perspective. The budget reallocation, as well as the adoption of carbon tax, can finance the loan scheme.

⁴ For example, the NEDO programme earmarks about ¥ 1 billion (US\$ 9 million)/year for energy efficiency subsidies, but solar heat subsidy constitutes only part of the whole budget share.

On the carbon tax, several studies have been carried out to identify the appropriate rate (CEC, 2001, JACSES, 2002). The volume of budget raised through the carbon tax will vary depending on the tax rate. The budget can be earmarked to the environmental causes, such as the thermal heat loan scheme, although it can also be also "recycled" to the industry to strengthen their competitiveness, as in the UK, where its climate change levy is returned to the industry as a social benefit discount.

Overall, there are many financial resources available to initiate the most important policy options for Vision III. The effective allocation of the existing revenues can keep the implementation of the Vision within the resource constraints.

After ensuring that the immediate actions are taken, more sophisticated market mechanisms can be introduced to take over some options. For example, large-scale wind power farms, which may not be financially feasible in the current circumstance, can be developed under the Feed-in tariff support. Further, the Renewable Portfolio Standards can replace the Feed-in tariff. The EPRDSA can be again re-allocated to new causes, after it has been used to fund renewable

electricity.

The new causes can include the intermediate actions such as the preparation of fuel cell infrastructure. It is not certain what source will be dominant in terms of hydrogen supply. Many in Japan argue for petroleum as the main source of hydrogen, as it does not require additional infrastructure (e.g. 55,000 petrol stations). Getting hydrogen from petroleum is, however, not as environmentally desirable as getting hydrogen from other sources, especially natural gas. On the other hand, methanol, natural gas, liquid petroleum gas have their own advantages, but the lack of necessary infrastructure is restricting their uptake (METI, 2001c). The EPRDSA may be able to fill this gap.

6.4.5 Discussion on Vision III Policy Path

6.4.5.1 Phasing

Achievement of the targets through the above policy package depends on to what extent fuel switch takes place from fossil/nuclear to renewables, and whether fuel cell transport is widely available before the target year.

Since the Vision does not assume large-scale reduction of demand, technological solutions have to be extensive, and the cost of adopting new technology can be expensive. For example, the energy requirements for transport are steadily increasing, and it can offset the effect of renewable electricity production. The achievement of the Vision may thus be undermined by the energy demand increase.

6.4.5.2 Cost

There is a prevailing view that the cost of renewables is high, compared to the other commercialised energies. However, as Shoen (2001) described through the Dutch experience, the cost of the technology will be reduced over time, as their availability increases (The price of solar power in 2000 reduced to 1/3 of 1991 level). The policy options identified under the Vision III were to create a momentum to develop renewable technologies by optimising their cost reduction.

For a large-scale installation of renewables, the matter of grid management has become critical. It is pointed out by experts that stability of electricity current on the grid would be significantly affected, if a large number of renewables

connected to the grid without sufficient technical alternations⁵. This means that unless there is a socially agreed way to bear grid improvement cost, large-scale renewable introduction may result in a massive electricity fluctuation, which would cause disruption to the normal life of society. It is important to identify how arrangements should be made to finance such an improvement.

Overall, short term cost increases may be expected through the implementation of this package, especially due to the fact that there are a wide range of options in place. In the long run, however, the mixture of demand management, as well as supply-side strategies, enables the reduction of implementation costs. It decreases the costs associated with the technological fixes.

6.4.5.3 Uncertainty

The most significant uncertainty involves political will. Japanese decision making, especially in a political context, is notorious for its conservatism. Radical change, particularly related with the crucial steps like feed-in tariff, was practically

⁵ The “grid and renewable” issues prompted the EU and its member states to take a number of initiatives to study the technical and financial shared responsibility as to the grid improvement. One of the examples is the SUSTELNET, a project funded by the European Union. Further information is available at: <http://www.sustelnet.net/index.html>

abandoned in favour of the interests of utilities.

At the local level, there are many initiatives taken up, such as that one local government establishes a guideline which demands the utilities to purchase locally produced renewable electricity, though it is not an obligation but rather a “voluntary” nature. Local initiatives like this may gradually pave the way for renewables, especially if there are others to follow this example.

Even when there are the bottom-up approaches taken at local level, a question remains whether renewable energy can really provide the baseload to a whole nation, especially in an absence of other measures to reduce energy demand.

6.5 Policy Package for Vision IV (“Ecological Footprint”)

6.5.1 Description of Policy Path

There are similarities between the Vision IV and other Visions, as they have the same kinds of gas and renewable strategies, while the distinctive feature of the Vision IV is that it includes many demand management options.

6.5.2 Immediate Steps

The immediate actions required for the Vision IV have the similarity with the Visions II and III. Financial restructuring and re-allocation of several budgets to renewable energy and energy efficiency programmes are among the highest priority, as they are in the other Visions. Robust renewable energy supports (e.g. introduction of Feed-in tariff and priority access of renewable electricity to the electricity grid) should also be adopted as immediate actions, as in Vision III.

Land-use options to reduce the transport demand were favoured by many experts as effective and urgent options. Also some cross-sectional and social options were ranked as being of a high priority. In addition, social options (e.g. green procurement) should be extended, and a strategic issue of how national energy forecast is made should become the core of the road map.

6.5.3 Intermediate and Long-term Steps

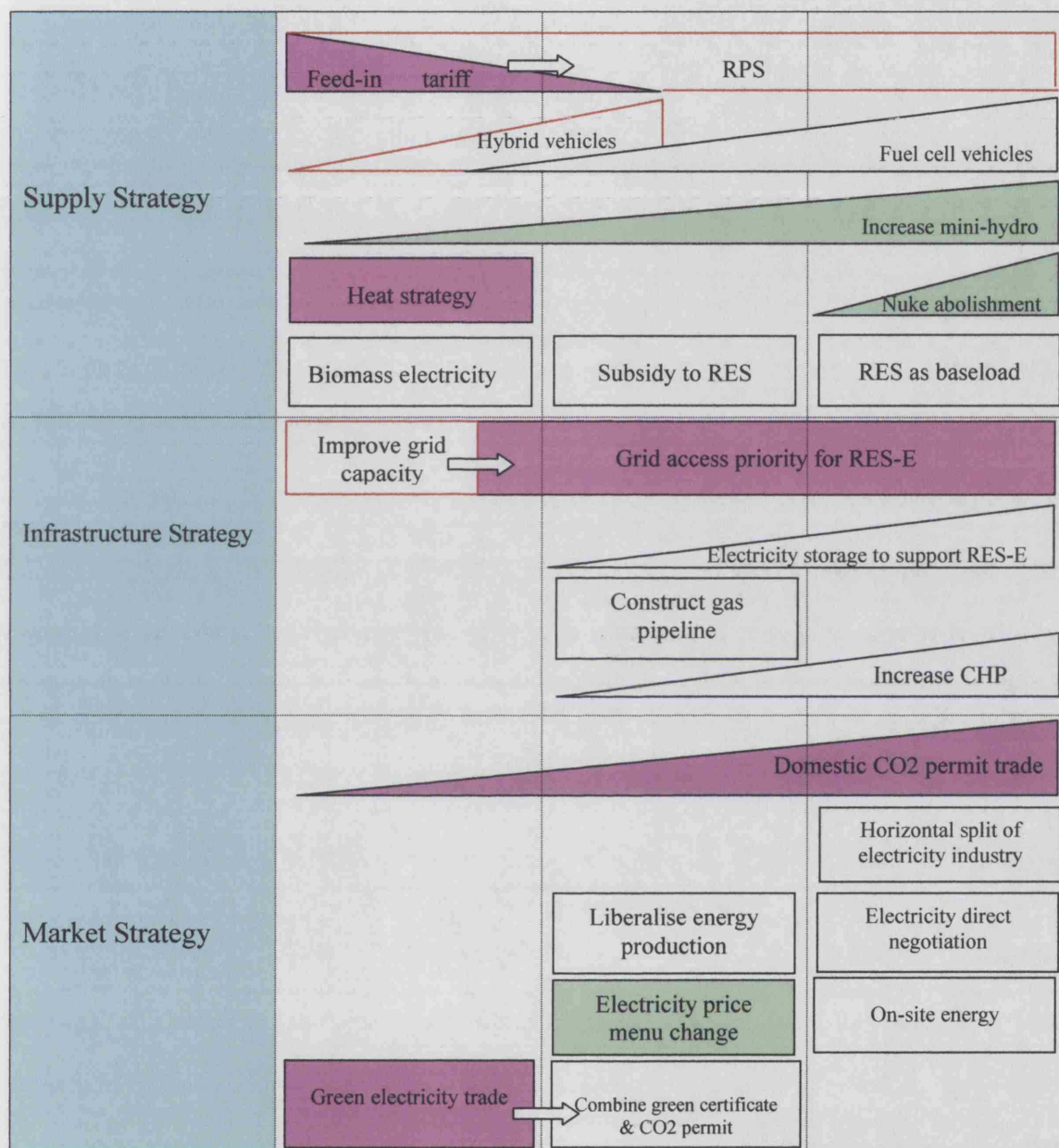
Technical solutions (e.g. fuel cells) will be gradually available as intermediate options. The development of the gas pipeline should also be initiated. The combined effect of carbon tax and the gas pipeline would be the acceleration of

the fuel switch from coal to natural gas. In fact this facilitates further market liberalisation of energy industry. The market liberalisation should be accompanied by tightening of the regulatory requirements for stricter energy efficiency for vehicles, electrical appliances and buildings.

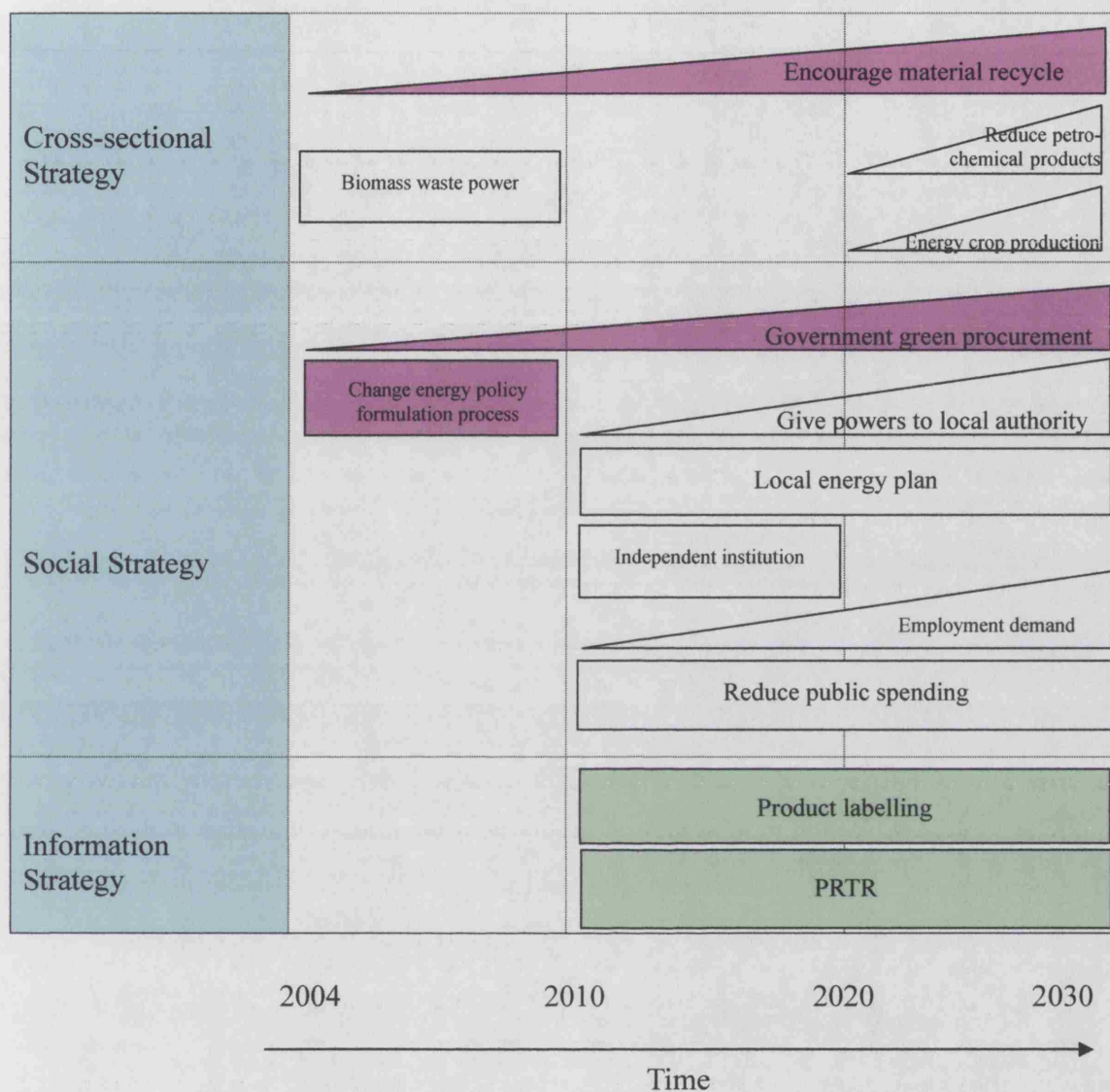
Intermediate solutions should also include the options which may not be directly associated with energy use reduction, but necessary in terms of their wider socio-economical implications. Identifying local autonomy as an important energy unit, and providing financial support to local initiatives with the stipulation of the duty to draw local sustainable energy plan are the steps for sustainable local energy management.

In the long term, the options which were not necessarily given high scores will hold their ground. The potential of technical solutions (e.g. electricity storage system), which is getting wider attention, may be greater, and technological progress may be made in this field. Coal gasification is expected to be commercially available around 2020, and will have a significant implication for the energy security perspective. The options to reduce material use, which do not necessarily get the highest attention of energy experts, should be much more widely debated in the long run (Figure 6.5).

Figure 6. 5: Road map for Vision IV



Financial Strategy	Reallocate EPRDSA		
	Reallocate petroleum account		
	Reallocate general budget for RES		
	Passenger car tax	Coal tax	
		Carbon tax	
Regulatory Strategy			On-site energy
			Virgin material tax
	Tighten fuel efficiency standards		
		Product efficiency	Penalty for non-efficiency
		Efficient building	Coal gasification
		CO2 in EIA	RES for housings
			Limit IPP fuel choice
Land-use Strategy	Revise land-use regulations		
	Transport policy to reduce demand		
	Lorry sharing	Quality of public trspt	Inter-port logistics
	Reduce transport demand		Fleet railway
	Metropolitan public trspt		Parking space regulation
	Revise regulation for RES		



6.5.4 Resource Implications

Apart from the common options discussed previously in the other Visions (e.g. the gas pipeline and the Feed-In tariff options), the key to achievement of the Vision IV is to what extent demand management is put in place.

For demand management, the transport sector holds a key role. The concept of sustainable transport has yet to be fully adopted by the Japanese planning systems, leaving a large potential for further energy demand reduction through it. A review of national transport policy from the sustainable development perspective is urgently needed (Masuhara, 2000).

In terms of transport demand management, the most important change required is not technical but rather logistical. It is necessary to change the way in which people and goods stay or move. It is not necessarily expensive to restructure logistical arrangements, but some of the transport management options need financial resources.

It is also important to enhance the communication between the regulators and the fleet clients. In the Netherlands, the Dutch Ministry of Transport entered into a discussion with the fleet clients. According to the Ministry, by simply exchanging information on the cheaper modal options with the fleet clients, it succeeded in persuading them to reconsider the fleet logistics to reduce road transport. Though the direct application of the Dutch experience to other countries may be difficult, lessons should be learned so that the regulators to work with fleet companies for sustainable transport.

6.5.5 Discussion on Vision IV Policy Path

6.5.5.1 Phasing

It is assumed that achievement of targets through the above policy package can be easier than the cases under the other Visions, as energy efficiency actions would reduce the burden for supply-side actions. For example, the Energy Efficiency Law is currently requiring the industry to be 1% more efficient per every year. If, as in the Regulatory-7, the energy efficiency target is made legally binding, significant demand reduction may be possible. The combination of fuel switch from coal to gas, and the deployment of renewable electricity, can contribute to the CO₂ emission volume reduction.

In the intermediate term, fuel cells will have a great potential to contribute to energy planning. It would lead to the more de-centralised energy production-consumption pattern, which will reduce energy losses and inefficiency. For the fuel cell technology, one big infrastructure needed is the gas pipeline, but its financial and other implications were already discussed in the Vision II. As long as the listed options are put into place, the achievement of the Vision will be

feasible.

6.5.5.2 Cost

Due to the extensive coverage of policy areas, the cost associated with this policy path may be the highest among all the road maps. The careful re-distribution of existing financial resources may enable sufficient funds to be raised to cover most of the costs required. Also, some options may increase the economic advantage through social and environmental investment. Fuel cells, for example, are seen as a key environmental technology, which could create cutting edge to the Japanese industrial competitiveness. Thus, there is a potential that environmental investment may induce long-term economic benefit, therefore it is probably too simple to consider the Vision IV policy paths as “expensive”.

6.5.5.3 Uncertainty

There is much uncertainty associated with the package, due to the number of measures involved. This package has features of demand management which requires social consensus. Whether the society agrees on the need of the identified options or not is the key to the package implementation.

So far, the Japanese society in general is quite enthusiastic about environmental issues, though the people's concern is rather limited to the issues close to their daily life (e.g. separate collection of waste, conservation of local natures). The political decision-making is, however, not necessarily matching up with the popular feeling⁶. The people's interests and concern over the environmental issues, with the right stimulation, can easily be linked to necessary actions associated with energy problems. Whether the Vision IV package is feasible or not depends on the extent to which the political decision-makers take the people's potential environmental enthusiasms into the energy policy formulation.

6.6 Implementation Analysis: Barriers and Responsibility for Change

6.6.1 Severity of Implementation

The Vision I is characterised by its weak targets and minimum policy choices. The Vision II has features of managerial solution mainly by inter fossil fuel change.

⁶ The decision makers are rather acting against the people's potential interests, by e.g. promoting nuclear power as an energy source without CO₂ emission.

The Vision III is represented by its emphasis on renewable technology development, and the Vision IV is mixture of demand management and supply oriented actions.

As the weaker CO₂ targets were established for the Vision I and II, they would probably require less severe implementation of identified policy options, whereas for the Vision III and IV, stronger commitment is critical. The political intervention would certainly be the key to their road map implementation.

Nevertheless, barriers for change exist no matter which Vision is pursued, and the responsibility for change has to be identified for any change to materialise. The following sections discuss those issues in detail.

6.6.2 Barriers for Change

There are several key parties potentially involved in implementation of the packages. They are: politicians, government (and its associated agencies), industries, NGOs, academics and citizens. As with many similar cases in countries elsewhere, the government and industries tend to neglect environmental imperatives. Environmental NGOs are often the chief driving forces behind policy

formulation and implementation, though their influence is rather limited.

One of the biggest barriers to the change is the opposition from the industrial sector, legislators and bureaucrats with vested interests. For example, the feed-in tariff was seen as a threat to the electric utilities, to the extent that the renewable portfolio standard (RPS) was favoured by the government and industry, as it specifies the maximum obligatory threshold and can function as a counter concept to the feed-in tariff. These two policies (Feed-in tariff vs. RPS) was debated in the government committees, and the policy struggle became intensive⁷.

It is also expected that there will be strong opposition to the financial re-structuring. Restructuring of the existing special-purpose revenues could be fairly difficult, as bureaucrats and legislators who have vested interests would strongly oppose the change. A recent example comes from the reform of the road fund. This is one of the special purpose revenues, and the proposal is to break it up with the fixed purpose as road construction. The plan, however, was greeted with turmoil. This suggests the similar backlash will be inevitable to the EPRDSA re-allocation, if ever that emerges on the policy agenda.

⁷ The RPS was finally stipulated as a law and in effect since April, 2003. Under the law, the utilities have obligation to supply RES-E. The adoption of RPS makes the chance of the feed-in tariff being introduced in Japan extremely slim.

Mechanisms such as carbon tax and domestic carbon emission trading are under discussion at government committees. The Central Environmental Committee recognised the need to introduce those policy options in its interim report for the climate change strategy (CEC, 2001). Through these strategic level discussions, the gridlock to policy changes may be gradually removed.

6.6.3 Responsibility for Change

As seen in Chapter 2, the Ministry of Economy, Trade and Industry (METI), which has general responsibility over energy issues, should take a number of initiatives. For example, one significant change is required under the Vision IV to change the way in which national energy forecast is drawn (Social-2). The General Resource Energy Committee, under the auspices of the METI, is responsible for the formulation of the Long-Term Energy Forecast (LTEF). In July 2001, it produced a new version of LTEF (METI, 2001b). Upon formulating the new LTEF, some committee members protested the way in which LTEF was drawn, as they believe that the new LTEF does not reflect the issues and opinions discussed throughout the committee meeting and the subsequent public hearings (Kyodo, 2001a). Their opinions were treated as reservations, which was a highly

unusual practice in the LTEF history, as it normally requires the unanimous support of all committee members. Although reservations were made, however, that has little impact on the way that the LTEF is drawn. The chairmen of the committee and the bureaucrats behind it have to recognise the importance of democracy and respect the committee discussions and procedures.

The Ministry of Land, Infrastructure and Transport (MLIT) is also responsible for sustainable transport management. As suggested by the Dutch example, the concept of sustainable transport urges the Ministry to act beyond the traditional role. The Ministry has to cooperate with other government departments, such as the Ministry of the Environment and the Ministry of Finance to take necessary actions. The Ministry of Finance should support the financial restructuring and reallocation of the budgets.

Industry is required to continue and tighten the energy efficiency levels for both its activities and products. Experiences have shown that industry can change its attitude, if it recognises sufficient pressure and economic benefit through environmental actions. The government and the public have to give those pressures and the economic imperative to the industry.

The responsibility for the media is huge, as it can influence on opinions of the legislator, the industry and the public. The Japanese mass media is generally weak in challenging the authority. Environmental anomalies, for example, are covered by the media often after serious incidents occurred. The commercialism is too strong to decide the issues taken up by the private media and the client preference penetrates the programme choice, while the public media cooperation (NHK, an equivalent to BBC) is extremely short in addressing problems. Alternative media, as in the internet, is still so much in its infancy that has little influence on the public. A novel way to fund a proactive programme in mass channels may be necessary to change the inactive media culture currently observable.

The scale of the environmental NGOs is rather small in Japan, and their activities are just maintained by their members' individual excellence. Nevertheless, together with mindful academics, extensive effort of the environmental NGOs often creates cutting edges to policy actions. Their continuous activities would certainly be one driving force for future policy changes.

6.7 Concluding Remarks

In this chapter, several policy paths were developed, reflecting policy option

effectiveness and priority evaluated by selected experts. The "road maps" presented in this chapter are designed to clearly demonstrate the range and priorities of available policy options, which could link the present situation with specific futures. The policy packages are analysed from a various aspects, which include resource implications, achievement of targets, as well as barriers and responsibility for change.

Main barrier identified is institutional conservatism. Sufficient (financial) incentive would be the key break through the conservatism. Cost considerations are another barrier. The cost of the alternatives are often overestimated by narrow and short term economic arguments. If the cost definition is widened to take externalities into consideration, the range of feasible alternatives would be effectively expanded.

Table 6.1 summarises the overall discussions on the four road maps. The Vision I and II may seem less expensive than the Vision III and IV, as it does not require radical changes and the associated economic costs. The Vision I, however, does not change the existing national budget structure, which pours large amounts of public funds into rather wasteful purposes. The conventional cost arguments do not deal with those distributional issues.

The prescribed CO₂ target for each individual Vision may be achievable through each corresponding road map, as the CO₂ target has already been set up to reflect different contextual elements (The Very Strong Sustainability, the Strong Sustainability, the Weak Sustainability and the Very Weak Sustainability). Achievement of the other targets, however, is questionable for some Visions and road maps. For example, Vision I and II and their road maps are weak in a liberated market, thus economic efficiency may not be achieved through their road maps. At the same time, Vision IV's strong emphasis on demand management and public involvement in energy decision making may have a high possibility of achieving the social efficiency target.

Table 6. 1: Summary of Discussion on Policy Paths

Vision title	Cost	CO ₂ Target Achievement	Market Efficiency Target Achievement	Social Efficiency Target Achievement
Vision I: BAU	+	Yes	No	No
Vision II: Gas Japan	++	Yes	No	No
Vision III: Renewable Emergence	+++	Yes	Yes	Yes
Vision IV: Ecological Footprint	++++	Yes	Yes	Yes

In the chapter 8, the road maps are put into a second validation process, in which

they are assessed by the selected experts from sufficiency, desirability, and several other aspects.

Chapter 7: SECOND ROUND QUESTIONNAIRE

7.1 Introduction

In chapters 5, the policy options as packages were presented. In chapter 6, the road maps corresponding to each Vision were demonstrated. The road maps are the graphic description of policy packages, identifying relative importance of options and the timing of their implementation.

As a next step, the research undertook a second round of the questionnaire survey. This maximises the interaction with the energy experts in order to enhance the validity of the road maps. This chapter presents the method and results of the second round survey. It also illustrates the revised road maps to reflect the views given by the experts.

7.2 Methodology for the Second Round Survey

The main purpose of the second round questionnaire survey is to obtain the experts' responses to the road maps on the following issues:

1. Sufficiency of policy options to achieve the relevant Vision
2. Timing of policy options to achieve the relevant Visions
3. Barriers to the implementation of policy options
4. Desirability of the Visions
5. Cost of the Visions

The road maps are presented to the experts, together with the questions which correspond to the above issues. A questionnaire was chosen to collect their responses, partly because of the limited availability of the experts, but also to maintain the independence of the opinions. In the questionnaire, supplementary information is also provided to explain details of the assumptions (Box 7.1). Comments were also welcomed on these assumptions.

Box 7.1 Questionnaire elements

A. Gas pipeline (Visions II·IV)

It is assumed that the construction of the gas pipeline would cost ¥ 4 trillion (US\$ 36 billion), as estimated by the Mitsubishi Research Institute (MRI, 2000). In the long term the gas pipeline is to be used to supply hydrogen. The government is assumed to subsidise the cost by half (¥ 2 trillion: US\$ 18 billion).

B. Renewable energy (Visions III·IV)

Non-thermal renewable energy includes the renewable energy sources, such as wind and solar. Thermal renewable energy covers heat or/and power from combustion of waste,

black liqueur and industrial wood waste.

For the feed-in tariff, 10 years after the introduction of the feed-in tariff, the new system, such as renewable portfolio standard replaces the feed-in tariff.

C. Carbon tax (Visions II·III·IV)

The main purpose of the carbon tax is to encourage fuel switch and energy efficiency. The tax rate is ¥ 300/million kcal (US\$ 2.7/million kcal). The tax to be recycled back to businesses and others in the form of reduced social benefit contribution.

D. Domestic CO₂ permit trade (Visions I·II·III·IV)

The total volume of domestic CO₂ permit trade is 30% of the difference between the annual emission volume of 1999 and 2030.

E. Transport demand management (Vision IV)

Transport demand management includes the options discussed in the Chapter 5, such as vehicle tax reform, encouragement of modal shift and increased transport efficiency.

F. Regulatory options to increase energy efficiency (Visions III·IV)

In order for energy demand management in household and commercial sectors, the scope of the current Energy Efficiency Law is to be expanded to vehicles and other equipment, which have not been covered by the law.

G. Subsidy for thermal equipment (Vision IV)

The low interest loan scheme for solar heat equipment continues until achieving the government target level (4.5 million kloe). After the achievement, more indirect options (e.g. tax reduction for energy efficient businesses and households) replace the scheme.

H. Encourage material recycle (Vision IV)

This is to encourage material recycling as part of final demand reduction policy. By 2010, 20% reduction is targeted for waste plastic and 40% by 2030.

The questionnaires were sent to 15 experts. This includes the 11 experts who were contacted on the first round survey. In order to reinforce objective assessment, more experts are invited to the second round, as it may be difficult to maintain unbiased judgement on the options and packages which the experts previously evaluated.

The "new" experts are chosen according to their specialisation and background in energy and climate change issues. In this round, 11 replied. Appendix D lists the respondents, and Appendix F for their comments. This research recognises that the overall number of respondents is rather limited. A great care has been taken, however, to select experts who are able to conduct strategic and forward looking evaluation of the policies.

Figure 4.1 described the flow of the research and the difference between the first and second round survey is that the former is to obtain the views of experts on the individual policy priority and effectiveness, while the latter is to validate the “policy path”.

7.3 Comments

On the 5 issues relating to the road maps identified in the Section 7.2, experts commented as follows.

7.3.1 Vision I

In the Vision I, Japan increases its energy demand. It is assumed that the demand increase is satisfied mainly by thermal and nuclear powers. Marginal level of demand management is carried out in the domestic, commercial and transport sectors.

7.3.1.1 Sufficiency of policy options on achieving the relevant Vision

Several experts have explicitly commented the sufficiency of the options under the Vision I (Gov1, Cons2, Cons4), though some additional options were suggested. One remarkable finding in the Vision I is that many experts treated the sufficiency of options and the legitimacy of target separately. For example, experts criticised the weakness of the target under the Vision I (“the target of the Vision itself is too weak”, “For the achievement of the Kyoto target, more

stringent policy options are required”) (Gov1, Ind3). They agree, however, on the sufficiency of options to achieve the target. It means they believe the options currently identified for the Vision I are enough to achieve the targets specified for the Vision I, but the targets, in their views, are already very weak, so its achievement is seen as fairly easy.

Several other suggestions include:

- Domestic CO2 permit trade and its packaging with carbon tax

Domestic CO2 permit trade should be packaged with policies which would give sufficient incentive to make the trading effective, e.g. carbon tax or levy would give such an incentive to the industry to take actions to reduce their CO2 emission (Gov1).

- EIA

Environmental impact assessment for power stations should cover CO2 emission volumes. The CO2 efficiency rate of natural gas power station should be established as the best available technology for thermal power stations (Gov1).

- Industrial agreement

The industrial community has made voluntary agreement for CO₂ emission reduction. The effectiveness of the agreement, however, has been questioned by many observers. One expert suggested the inclusion of the industrial agreement as part of the national global warming actions (Acd2).

- Petroleum account

One expert suggested that the petroleum account (PPAESA), as well as EPRDSA, should be reformed, because those accounts are getting losing their “reason-d’etre” (Cons3).

7.3.1.2 Timing of policy option to achieve the relevant Vision

On the timing of options, several experts recommended the earlier introduction of electricity price menu change. The regular pricing level has not reflected the different cost associated with time of use. The experts argue the tariff reform should be carried out to give sufficient “time-of-use” signals to the electricity users, as part of the market liberalisation. They suggest it can be introduced in the early 2000s, rather than after 2020 as indicated in the road map (Gov1, Ind1, Ind3, Cons4).

Also, experts urge consideration of CO2 in the environmental impact assessment.

This is regarded as a critical issue especially in the situation where nearly 20 coal power stations are under construction or planned (Gov1, Cons2).

Several experts consider the CO2 permit trade should be started earlier than indicated. The domestic CO2 permit trade has been, or will be, started in some countries, including the UK. The Japanese government and industry are keen to develop the system compatible with the international standard of such the trade. Given the “trial and error” period is required for the participants to get familiarised with the trading system, the earliest possible instigation of the domestic trade system was recommended by the experts (Cons2, Cons3, NGO1).

Other issues commented on is related to the timing of implementation:

- Earlier introduction of information strategies

Earlier introduction of the information strategy options, such as the PRTR and the CO2 emission product labelling, is commended by some experts (Gov1, Cons4, Acd1).

- Special account reformation

The special accounts in Japan, which include EPRDSA, are increasingly becoming a source of corruption. According to one expert, the reformation of EPRDSA is probably not sufficient. He insisted that the reformation should be extended to the special account as a whole (Ind3). Experts suggested the EPRDSA should be abolished for the achievement of the Vision I, as the tax account is used only for the development of conventional electricity sources (Cons1, Cons3).

7.3.1.3 Barriers to the implementation of policy options described in the road maps

Industrial and political opposition is considered to be the most prominent barriers for the option implementation (especially for the financial reform) would face a strong opposition (Gov1, Cons2, Cons4, Acd1, Acd2). One expert, however, commented that the most controversial issue would be the reformation of EPRDSA, thus *any other* financial restructuring than the EPRDSA may be possible in an intermediate time-scale (Cons2).

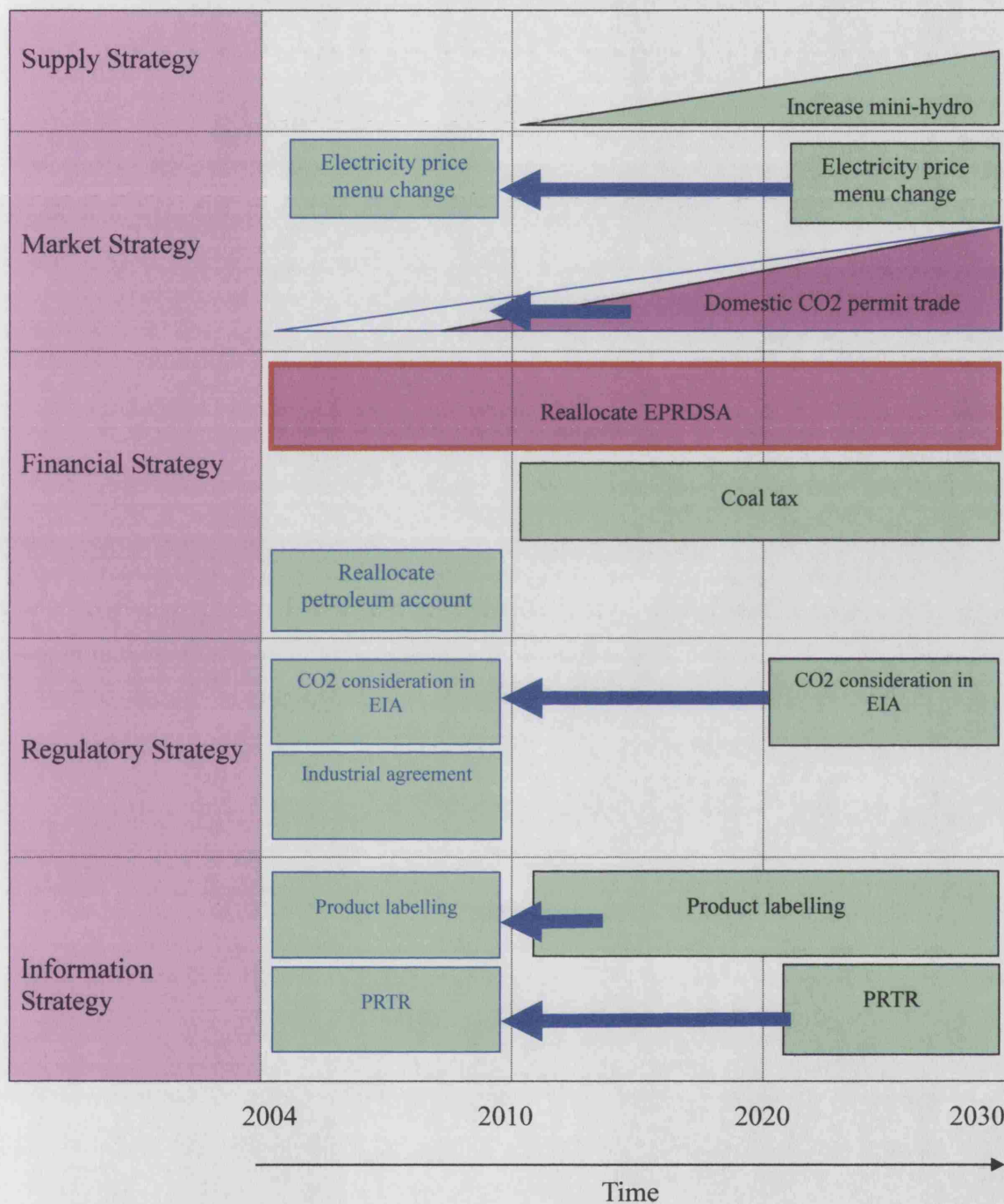
7.3.1.4 Desirability of Vision

No experts explicitly commented on the Vision's desirability, except one who agrees the Vision is, at least, one important step forward (though the degree of its aggressiveness is questionable) (Cons4). Many experts believe the Vision and the road map are easy to implement (Gov1, Ind3, Cons1, Cons2).

7.3.1.5 Cost of the Vision

The experts mostly agree that the economic cost of the Vision is little or, at least, less in comparison to the other Visions. There is a divided view, however, towards the social cost. One expert considered the Vision's social cost is high (Gov1).

Figure 7. 1: Modified road map for Vision I



Notes: Those in the blue boxes are newly suggested options. Arrows indicate the experts' suggestion to bring the implementation timing forward. Options in the red are thought to require greater level of change.

7.3.2 Vision II

In Vision II, Japan relies on imported energy (especially natural gas) on a massive scale. Demand management has given a little significance in this Vision, with equally little emphasis being placed on technological development for renewable sources.

7.3.2.1 Sufficiency of policy options to achieve the relevant Vision

Some experts regard the Vision's strong emphasis on fuel switch from coal to gas is not sufficient to meet the global challenge (Gov1). Demand side management is felt insufficient to ensure balanced approach (Gov1, Cons2). Also, fuel switching in the transport sector (in addition to the fuel switching in energy generating sector) is thought to be necessary (Cons3).

Comments were made on the issue of the technical difficulty of converting coal-fired power stations to gas-fired ones (Ind2). A comment is also given on the necessity of a long-term strategy on power plant replacement. This is because the fuel switch should be carried out not as a short-term action, but as a long-term

solution, requiring relevant strategies to replace obsolete power stations with new ones (Ind2).

Some experts agree on the importance of coal use reduction. They suggested that coal tax would be an effective way to give necessary signals to the market (Gov1, Cons1, Cons3). An expert with a gas pipeline consulting background recommended the earlier construction of the gas pipeline, as the lack of infrastructure may significantly undermine the feasibility of large-scale fuel switching (Cons1).

Other issues include:

- Demand creation for gas through town planning

The electricity sector's demand for gas is not sufficient to make the gas pipeline project cost-effective. Large increase of co-generation, through town planning is required (Ind3).

7.3.2.2 Timing of the policy option to achieve the relevant Vision

Experts recommended earlier introduction of a various options. For example,

carbon tax should be implemented at an early stage, so that it triggers fuel switching (Acd1, NGO1). Options relevant to wide use of gas, e.g. broader application of cogeneration and advanced gas technology are generally regarded as intermediate steps (Ind1, Cons3).

Other issues include:

- Earlier introduction of electricity price menu change

As is in the Vision I, electricity price menu change should be introduced earlier than indicated (Ind3).

- Timing of the EPRDSA reform

Although it is not really a suggestion, one expert considered it would take much time and effort to reform the EPRDSA, though it depends on how far it can be “reformed” (Acd2).

The road map is modified to reflect the above suggestions (Table 7.2).

7.3.2.3 Barriers to the implementation of policy options described in the road maps

Industrial and political opposition to the identified options are again regarded as one of the most prominent barriers (Gov1, Acd2). The question of who is taking the initiative for gas pipeline construction is also a limiting factor for the Vision implementation (Ind1, Ind3). Also, the cost of pipeline, involving the land acquisition, adds to the uncertainty (Cons1, Cons2).

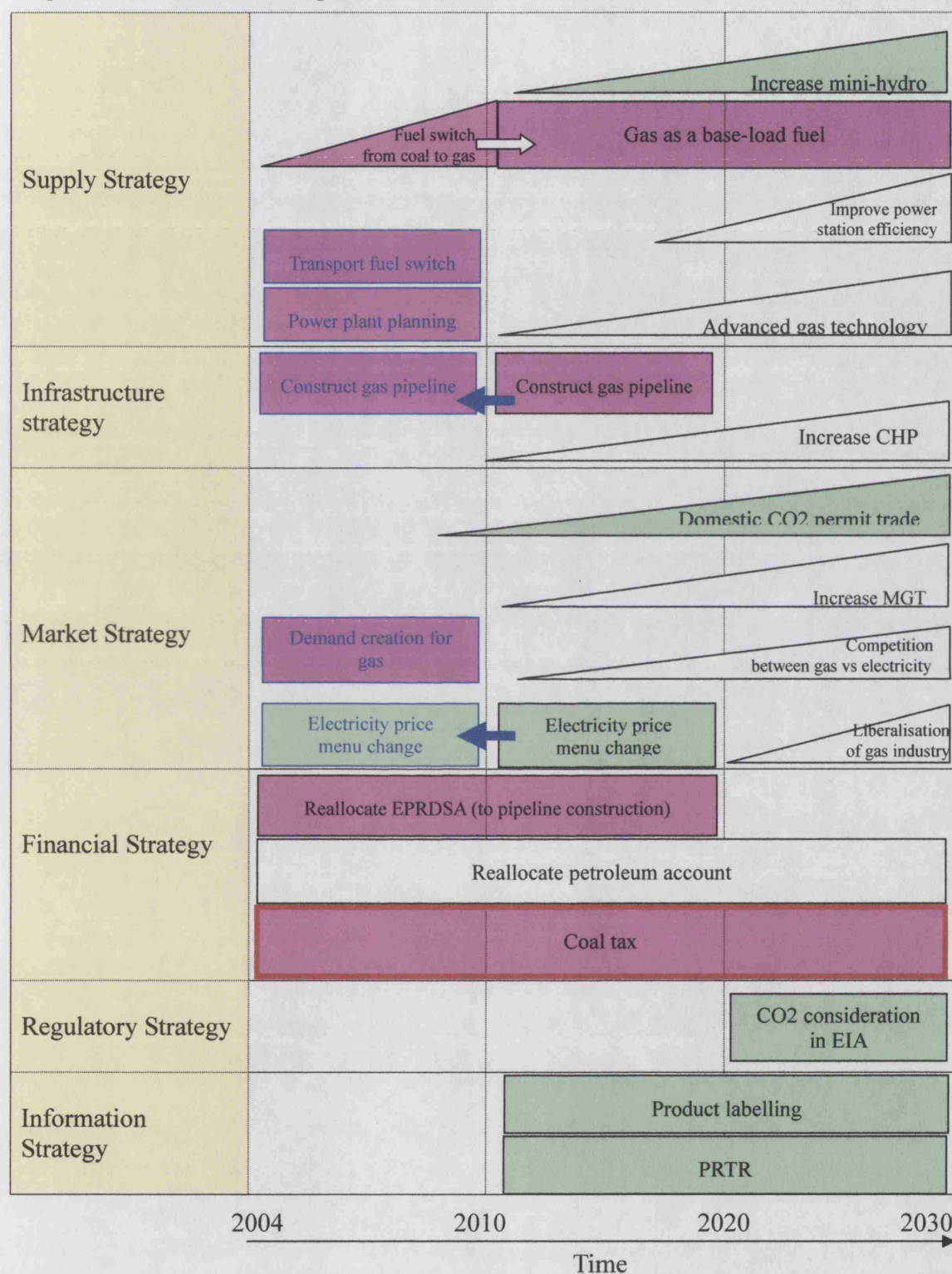
7.3.2.4 Desirability of Vision

Overall, the Vision does not get affirmative reactions from many experts, as it is regarded as weak in achieving the targets (Gov1, Cons2, Cons3, Cons4, NGO1.). Implementing the Vision is generally seen as difficult, since the construction of pipeline involves great uncertainty. Fuel switch from coal to gas may not be desirable from the energy security perspective. If Japan relies too much on gas, it will lose its bargaining power on fuel purchase negotiation. According to one expert, the Japanese coal technology is efficient, and it should transfer the relevant technology to developing countries (Cons4).

7.3.2.5 Cost of the Vision

The experts generally consider the Vision's pure economic cost is high, largely due to the pipeline construction (Ind1, Ind3, Cons2, Cons4). On the other hand, the experts believe the success of the Vision depends on how the natural gas supply through the pipeline is evaluated from the country's energy policy perspective. Detailed cost-benefit analysis would address the balance between the costs of pipeline and its benefits (Gov1, Cons1, Cons3, Cons4).

Figure 7. 2 Modified road map for the Vision II



Notes: Those in the blue boxes are newly suggested options. Arrows indicate the experts' suggestion to bring the implementation timing forward. Options in the red are thought to require greater level of change.

7.3.3 Vision III

There is a massive deployment of renewable technologies in the Vision III. However, decrease in demand levels in the Vision III is minimal.

7.3.3.1 Sufficiency of policy options to achieve the relevant Vision

There are many suggested options (Some of them are common to those suggested under the previous Visions). The experts consider the options are sufficient to meet the target, as long as they are “actually” implemented (Cons2, Cons4). Some experts, on the other hand, expressed their concerns on the Vision’s over-estimation of the renewable contribution (Ind2).

Suggested opinions include:

- Link support for foreign renewable capacity and domestic count for CO2 reduction

Experts commented that it is not clear in the road map whether the support for foreign renewable capacity is linked to domestic CO2 reduction. The road map

should stand on the assumption that the support for foreign renewable capacity is counted as Japanese CO2 reduction credit (Ind2).

- Low-grade heat utilisation

An expert recommended the low-grade heat utilisation as an effective way to increase energy efficiency (Gov1). He also suggested that the lifespan of Japanese architecture is too short, pushing up the demand for raw materials (which requires energy to manufacture), thus the option of making buildings last longer may be necessary.

- Priority access should be given to CHP

An expert believes that the priority access should be given not only to renewable energies, but also to CHP and fuel cells (Ind1). He also proposed that fuel cells for domestic uses should be included as a key option.

- Support local authority

One expert thinks it is necessary to support local authority to take up renewable energy development (Ind3).

7.3.3.2 Timing of policy option to achieve the relevant Vision

On the timing of implementation, experts recommended much earlier support for foreign renewable development (Cons2, Cons3, Cons4). They suggested that it could be done through the Kyoto mechanisms. As discussed, they feel it is necessary to link the foreign support and the credit that Japan gains. The Clean Development Mechanisms (CDM), a system developed as one of the Kyoto Mechanisms, carries an incentive for international cooperation through technology transfer from developed to developing countries, because the CO2 reduction credits can be attributed to the donor of the technology. The experts suggested, that the Japanese foreign support on energy technology should be strategically link with the CDM credits, to optimise the incentives for the Japanese side.

- Earlier electricity price menu change

As in the other Vision, the electricity menu change is identified as an option which can be introduced earlier than the indicated in the road map (Ind3).

- It is not clear how long the feed-in tariff should continue.

One expert commented it is not clear how long the feed-in tariff system should

continue (NGO1). The background to his comment is that he considers the feed-in tariff is an effective mechanism to encourage renewables, thus its phasing out needs careful consideration.

The road map is modified to reflect the above suggestions (see Table 7.3).

7.3.3.3 Barriers to the implementation of policy options described in the road maps

Renewable energy in general has been regarded as expensive by Japanese industry.

As the strong emphasis is given to the renewables in this Vision, opposition from industry would again be felt as a potent barrier for the Vision III policy implementation. Regulatory strategies for energy efficiency need careful consideration, because if the regulations are too tight, many small and medium companies will go bankrupt, which would further induce social costs (Cons4).

Other issues include:

- Defining the initial quota for CO₂ permission trade

On the domestic CO₂ permission trade, the issue of defining the initial quota

would be controversial, according to one expert. Also, for effective CO₂ permission trade, an appropriate mechanism is required to prevent the domestic “hot air” traffic (Gov1).

- Availability of hydrogen

An expert questioned where and how hydrogen is obtained, as the issue of hydrogen availability would affect the timing of the launching of the fuel cells (NGO1).

- Ministerial competition for policy formulation

The notorious Japanese ministerial competition would have to cease so that coordinated regulatory changes could be introduced. Air transport and other relevant regulations, for example, have to be changed to make wind power facility's construction easier. The air transport regulation is administrated by the MLIT, thus their cooperation with the METI (responsible for energy issues) is required (Cons4)¹.

¹ International cooperation would be another area requires the ministerial cooperation. For example, the MoE is responsible for negotiation on the development of international schemes for emission reduction, notably those under the Kyoto Mechanisms. On the other hand, the supervisory power for industrial behaviour is undertaken by the METI. The two ministries' cooperation is thus essential to effectively link the Japanese industrial actions, especially in the

7.3.3.4 Desirability of Vision

Experts generally agree on the desirability of the Vision and road map (Gov1, Ind1, Cons1, Cons2, Cons4) though some consider it is weak and inefficient as it depends on a number of regulatory measures (Cons4, NGO1).

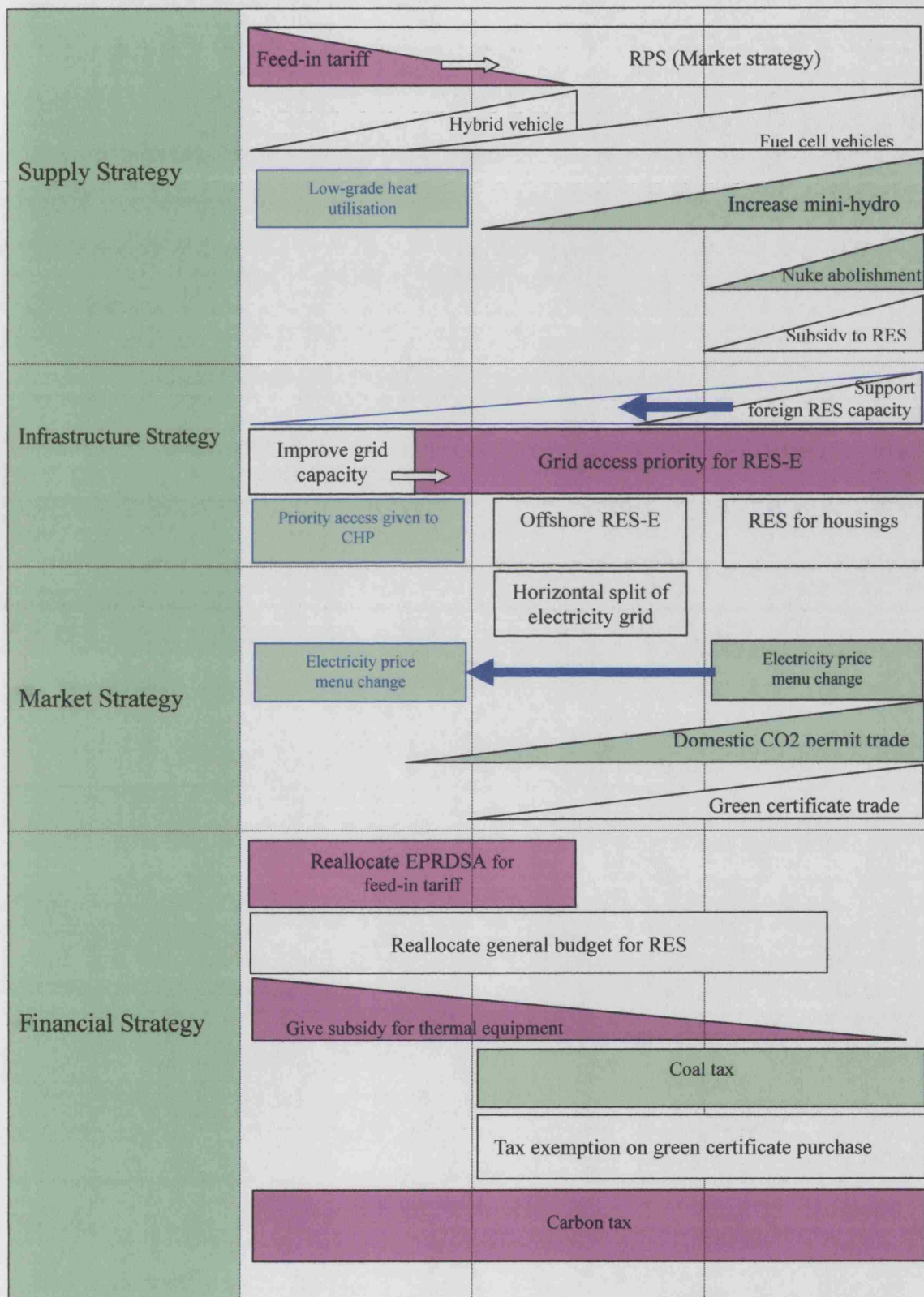
7.3.3.5 Cost of the Vision

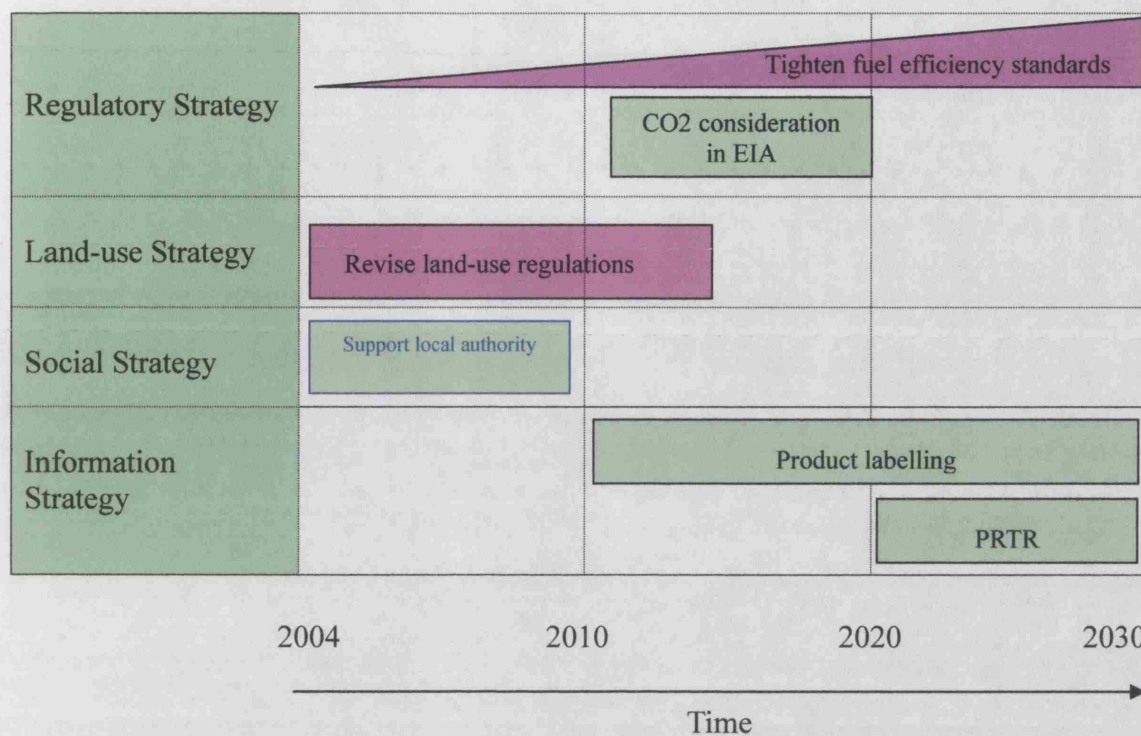
The experts stated that the social and economic costs are (relatively) cheaper with implementing this road map (Gov1, Ind1, Cons2), while others consider the cost could be high (Ind3, Cons4), particularly for fuel cells development (Cons3, NGO1). One expert expressed his concern that the options seem to be expensive, because the tight regulation would make the industry shift their production to foreign countries, forcing the already feeble Japanese manufacturers to lose out of international competition and that significantly undermine the social stability (Cons4).

Modification of the road maps was undertaken, to reflect the feedbacks.

developing countries, and credits generated through CO2 reduction under the Kyoto Mechanisms.

Figure 7. 3: Modified road map for the Vision III





Notes: Those in the blue boxes are newly suggested options. Arrows indicate the experts' suggestion to bring the implementation timing forward. Options in the red are thought to require greater level of change.

7.3.4 Vision IV

In the Vision IV, renewables plays an important role, while the demand level is significantly lower than in other Visions, as a result of massive demand management.

7.3.4.1 Sufficiency of policy options to achieve the relevant Vision

Some experts agreed on the sufficiency of options to achieve the Vision's target (Cons2, Cons4), whilst several additional options were recommended, including the following.

- The “real” recycle loop

In theory, if the material recycling increases, the virgin materials used in the manufacturing processes should decrease. In reality, however, though the recycling rate is going up, the share of virgin materials in manufacture is not decreasing. This situation is odd, and has to be changed through establishing the “real” recycling loop (Gov1).

- Energy management through town planning

Town planning has to be reorganised to accommodate energy (especially heat) management (Cons3). Also, from transport efficiency point, energy efficient town structure, which may be realised through the planning of small and medium sized towns with extensive use of public transport, should be put in place (Cons1).

7.3.4.2 Timing of policy option to achieve the relevant Vision

As in the previous Visions, electricity price menu change is again identified as the option which needs to be implemented earlier (Cons4). Forest management was recommended to be added to the road map. This is set against the background that the Japanese forestry business is deeply depressed, which results in deterioration of the state owned forests. In order to increase biomass production, a comprehensive forest management strategy is urgently required (Cons2).

Other options include

- Electricity storage more urgent than fuel cells

Electricity storage technologies include redox² flow, NaS batteries, etc. Also,

² Redox (reduction and oxidation reaction) stands for reactions in which reduction of an electron

electricity can be stored in the form of hydrogen. It is more urgent to make those electricity storage technologies widely available, rather than fuel cell development. The electricity storage technology can be a powerful substitute for many electricity storage functions currently deployed, such as pumped water power stations, which are getting increasingly criticised as the source of environmental destruction (Ind1).

- Earlier horizontal separation of electricity industry

Horizontal separation of the electricity industry can be introduced much earlier than indicated (Cons4).

- Financially support increase in grid capacity.

This option is to financially support increase in grid capacity. The financial support must not be injected into industry before it is clear how much funding is actually required for grid capacity increase (Cons4). This means that this option should be available after it is clear the horizontal separation is carried out to ensure the financial transparency.

is matched with the donation of an electron (oxidation).

- Earlier local authority empowerment

The empowerment of local authority can be introduced much earlier than indicated, as it requires a long period to materialise the effect (Acd1, Cons4).

- Earlier information strategy

One expert believes the PRTR disclosure, can be introduced earlier than indicated (Acd1). Another expert considers the introduction of CO2 product labelling may face strong opposition from manufacturers (Cons4).

The road map is modified to reflect the above suggestions (see Table 7.4).

7.3.4.3 Barriers to the implementation of policy options described in the road maps

Political and industrial opposition are again identified as the main barriers to the policy implementation (Gov1, Cons2, Acd1). Other issues include the following:

- Balance between revenue and investment

One expert posed a question of balance between expenditure and revenue under this Vision. Massive infrastructure investment, for example, would be required for

transport policy implementation, as well as for gas pipeline construction. Also, renewable energies receive much investment and government financial support. On the other hand, energy-related revenue may shrink, if the energy demand is reduced as intended under this Vision. As the industrial structure, GDP and tax revenues are all interconnected, very careful consideration should be given to make the correct balance (Cons4).

- International trade relationship

Tax reform to give incentives to energy efficient vehicles may spark an international trade dispute, especially with the US (Cons4).

- Lack of incentive for household sector

Under the Vision IV, there are many options which focused on the development of household actions. It is questionable, however, if there is sufficient incentive for the household sector to take up the options indicated (Cons3).

7.3.4.4 Desirability of Vision

Some experts explicitly agree on the desirability of the Vision IV (Gov1, Cons2).

Some others are concerned with the nature of the Vision IV, which may require

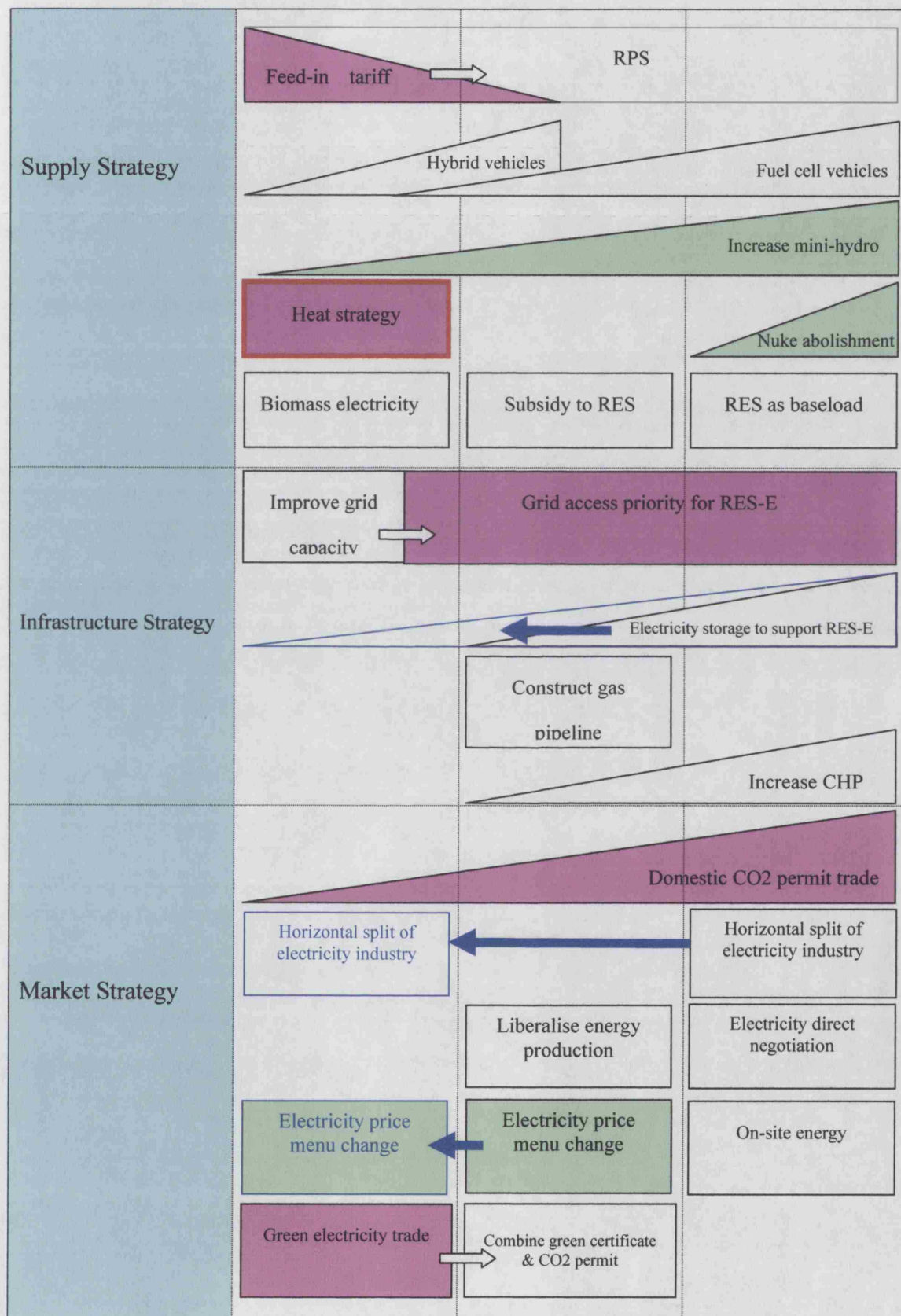
strong governmental intervention for implementation, and it may go against the observable trend in Japan to seek “small” government (Ind3). It may not be necessarily desirable that the central and local government take a strong initiative in terms of energy strategy formulation. The government’s obligation may be better directed at sending key signals to the market (Cons3).

Some experts consider the implementation of the Vision IV difficult, because they think many of the options require very strong governmental intervention and financial support (Cons2, Cons4).

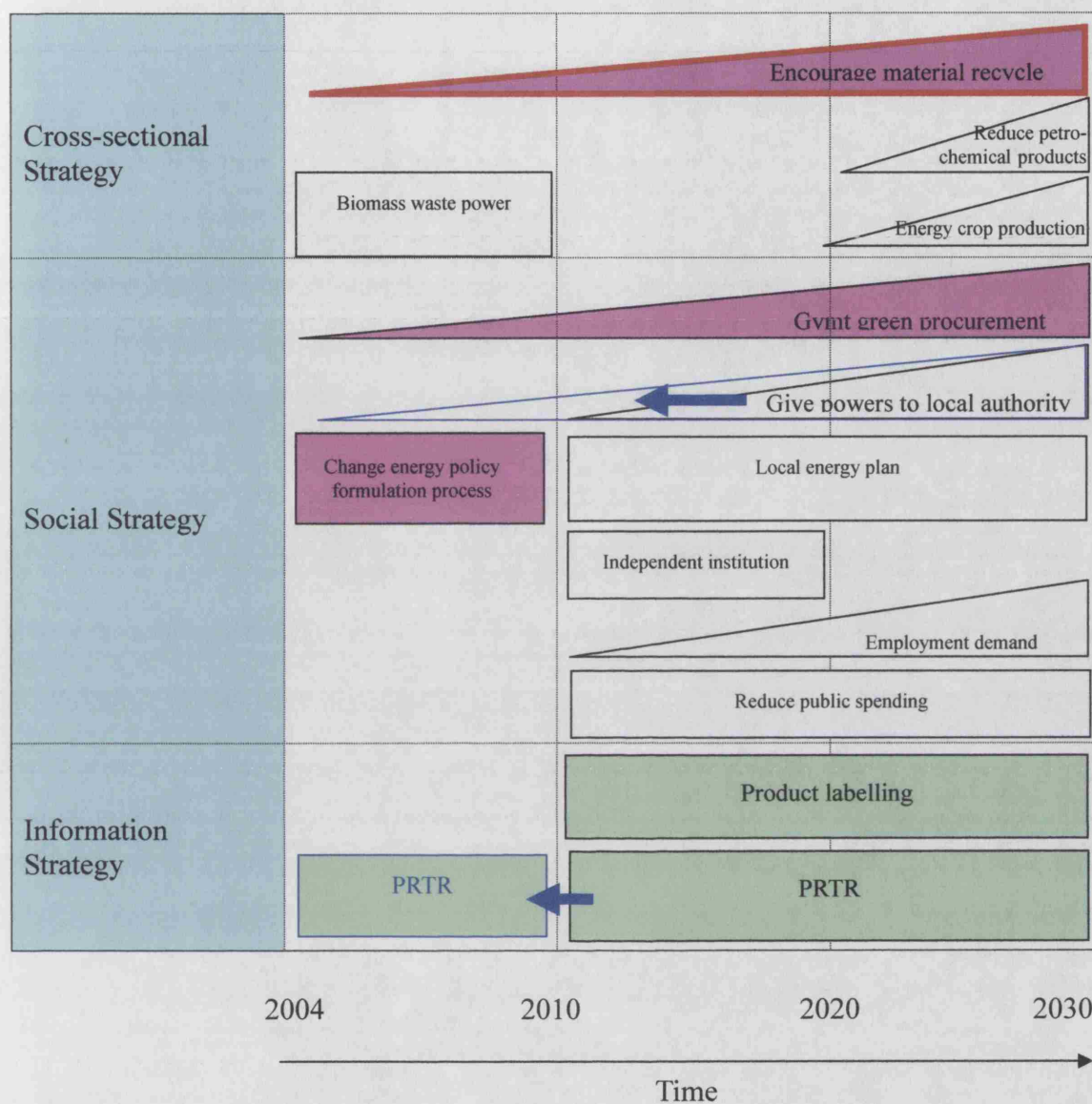
7.3.4.5 Cost of the Vision

Several experts see the economic cost of the Vision IV as large (Ind1, Ind3, Cons2, Cons3, Cons4). The social cost of the Vision, on the other hand, may not be high, depending on how the social cost is defined (NGO1). One expert considers social cost, as well as economic and administrative cost of the Vision IV, is small (Gov1). Experts think it is crucial to determine how society interprets "social cost". The social consensus (to take the externalities reflected into the market) is essential to put these options into practice (Cons2)

Figure 7. 4: Modified road map for the Vision IV



Financial Strategy	Reallocate EPRDSA		
	Reallocate petroleum account		
	Reallocate general budget for efficiency		
		Coal tax	
		Carbon tax	
	Tax change for passenger car	Financially support grid improvement	On-site energy production
			Virgin material tax
Regulatory Strategy	Tighten fuel efficiency standards		
	Product efficiency		Penalty for non-efficiency
	Efficient building		Coal gasification
	CO2 in EIA		RES for housings
			Limit IPP fuel choice
Land-use Strategy	Revise land-use regulations		
	Transport policy to reduce demand		
	Lorry sharing	Quality of public trspt	Inter-port logistics
	Reduce transport demand		Fleet railway
	Metropolitan public trspt		Parking space regulation
	Revise regulation for RES		
	Forest management		



Notes: Those in the blue boxes are newly suggested options. Arrows indicate the experts' suggestion to bring the implementation timing forward. Options in the red are thought to require greater level of change.

7.4 Concluding Remarks

In this chapter, the methodology and results of the road map validation process have been presented. Many highly valuable comments were provided by the experts on the following issues:

1. Sufficiency of policy options to achieve the relevant Vision
2. Timing of policy option to achieve the relevant Vision
3. Barriers to the implementation of policy options described in the road maps
4. Desirability of Visions
5. Cost of the Visions

Analysis on whether and how the scenario can be put into practice is a highly important issue, though many existing scenarios studies are formulated without regard to their “implementability”. The research found it particularly useful to conduct the validation process as a procedure for getting expert opinions on the Visions. Each road map received recommendations which reflect the different emphasis given to the Visions and the road maps. The road maps were modified to reflect the experts’ responses. The validation process highlights the

implementation aspects of scenario and road maps.

Table 7. 1: Summary of Expert Validation

	Vision I	Vision II	Vision III	Vision IV
Sufficiency	+(−)	−	+	++
Timing	Individual evaluation	Individual evaluation	Individual evaluation	Individual evaluation
Barriers	+	+++	++	+++
Desirability	--	−	+	++
Cost	−	+++	++	+++

Table 7.1 summarises the expert validation. Overall, the experts consider the Vision I options are sufficient to achieve the target, though the target level would be too weak to meet the global challenge. On the Vision II, it is questionable that the options strong emphasis on supply-side action (e.g. fuel switch from coal and petroleum to gas) is satisfactory to achieve the target. The Visions III and IV options are believed as sufficient, though they may require more financial and other dedication.

Many comments were made on timing of introducing individual options. Strong emphasis was given by the experts to implement many policy options earlier than previously suggested, and place each option in the “right” context. Electricity pricing change, for example, is recommended to be carried out as part of the

on-going market liberalisation process.

Industrial and political oppositions are the main barrier for any of the Visions to be implemented, though their degree vary depending on each Vision. It seems that the experts see the Vision I receives the least opposition. In the Vision II, the cost and risks associated with the pipeline construction would form the main barrier. The Visions III and IV require strong government intervention that may trigger industrial antagonism. As the Vision IV is intending demand reduction, government revenue from energy consumption may be reduced. Thus the balance between revenue and investment adds an additional uncertainty to the Vision IV. Under any Vision, strong “Bottom-up” push from the public is a key to creating sufficient driving force to secure the required changes.

The experts generally consider the Vision III and IV road maps as desirable, while the Visions I and II are not. Their desirability judgement is strongly linked with social and environmental benefits, e.g. emission reduction and democratic energy decision making. The Visions III and IV, however, are not immune to their criticism, as they are based on strong regulatory intervention by the central government.

The experts stated that the cost of the Vision I is little, or less in comparison with others. They see the pure economic cost is high for the Visions II, III and IV, as the featured elements for the individual Visions would involve large-scale financial commitments (e.g. on gas pipeline for the Vision II, renewable investment for the Vision III and demand management for the Vision IV).

The social and environmental costs for the Vision I would be high, whereas these costs for the other Visions are depend on how the externalities are evaluated. The gas pipeline and fuel cells development, for example, require financial resources, but their social and environmental merits may exceed the cost. For the Visions III and IV, care is needed to consider how the industry would react to a tight regulatory environment, as they may shift their manufacturing bases outside of Japan, to the extent that the domestic social stability is undermined.

Based on the whole analysis, the Visions III and IV are favoured by the experts, though the Visions I is most likely to be the reality. The Vision IV is highly desirable, but extensive coverage on demand management options draw reserved opinions among the experts, as it demands the social consensus to accept such demand reduction. Strong government presence is also needed under these Visions. The Vision III may be more modest than the Vision IV in terms of policy

requirement, and is more likely to be implemented, though the lack of demand side management may create a challenge at a later stage.

The next chapter reviews the whole research, and discusses both methodological and contextual findings.

Chapter 8: DISCUSSION AND CONCLUSION

8.1 Introduction

Energy has been long seen as a driving force behind economic growth. Since the industrial revolution, the mass utilisation of energy has been fundamental to modern society. The correlation between energy use and the growth of economy is also seen in Japan, as a massive resources are imported as fuel. There is, however, an increasingly widespread recognition that the environmental impacts associated with the energy use are causing significant threats to the sustainability of the earth ecosystem, and this is fundamental to human existence. The climate change problem is the most prominent example of these threats. There is growing recognition that drastic policy change is needed to trigger the restructuring of the societal and economic system, so that human activities can be maintained within the capacity of nature.

In order to respond to these challenges, this research applies the normative policy approach to the Japanese energy context. This chapter discusses key elements of the methodological and research findings. Several recommendations were also proposed from policy, organisational, methodological and academic perspectives.

8.2 Methodological Findings

8.2.1 Methodological Procedure

In the research, four Visions were established which were accompanied by the scenarios that describe feasible hypothetical story lines to reach the Vision. The four Visions were labelled as the BAU, the Gas Japan, the Renewable Emergence and the Ecological Footprint.

The targets were established for each Vision. For Visions I and II, moderate targets were selected to reflect the weaker social readiness to accept change, while more stringent targets were chosen for Visions III and IV, as they have a stronger social readiness for change.

Each scenario was followed by detailed policy packages. Policy packages are the group of policy options which are thought to be required to complete a Vision. Particular sets of policies were grouped, based on emphasises given to individual Visions and scenarios. Also, selected policies were packaged to form the “common elements”, which are identified as the options that need to be

implemented irrespective of what Vision is pursued, and are the *core* policies for all the policy packages.

Experts were then invited to give comments on the priority and effectiveness of each policy option. Energy experts were chosen, based on their knowledge and specialisation. Based on the experts' comments, policy packages were organised in the form of road maps. The road map, which uses a visual presentation, coordinates the policy package in a chronological order. Also, potentially significant policies were clearly marked, so their relative importance is easily recognised. The road maps were then presented to the energy experts for the second time. Comments were invited on the validity aspects of the road maps. The experts' comments form the basis for some modifications to the road maps.

8.2.2 Methodological Findings

8.2.2.1 Road Maps

The research found it particularly useful to construct road maps, which enable a visual presentation of available options. The visual character of the road map helps to overcome one of the limitations of scenario studies. Scenarios are, for

example, often presented as a package of plausible events, but details as to how those plausible events unfold are not clearly illustrated in many cases, whereas the road map is capable of demonstrating which policy option was given a higher priority, and how the different options were grouped and interact with each other. The visual illustration of available options was beneficial in the explanation of option details to the experts whose "correct" understanding and responses are particularly valued. It would probably be useful, too, to present road maps to different groups of people, including policy makers and citizens.

The research also discovered the road map is a good way to present policy priorities. Policy priorities are often overlooked in scenario studies, and all the policy options tend to be treated as if they have to be implemented at the same time in some scenario studies. It is, however, critically important to recognise some policy options have to be implemented earlier than others, and *vice versa*. Grid capacity improvement, for example, is identified as one of the prerequisites for the expansion of renewable electricity, because priority access of renewable electricity to the grid is only possible when there is enough grid capacity. Thus, although the grid capacity development itself does not necessarily have a strong potential to reduce CO₂ emission, the early implementation of this option could bring a significant difference in renewable development (with CO₂ reduction)

prospects. The road map is able to present these chronological requisites.

Another advantage of the road map is its capability of demonstrating the relationships between different options. The combination of policies and synergies among policy options are often neglected in the scenario studies. By describing various kinds of policy options in one table, it was possible to see the relationship among different options. For example, the construction of gas pipeline (a supply strategy) enables more competition among energy industries (a market strategy). Road maps can help makes those intricate relationships clearer among available options in different categories.

Not many other scenario studies, however, have employed the road map methodology, especially in the Japanese context where many of the existing studies have concentrated on numerical simulation. As the “road map” can enhance the transparency in the policy package, it should be recognised as a significant element in scenario studies. Also, as long as reasonable assumptions could be made on effects of individual options, calculation of the CO₂ emission volume after the road map implementation would be possible. Further open debates may be possible, if the road maps could be developed as computer aided decision making models.

8.2.2.2 Interaction with the Experts

Another methodological finding is the usefulness of interaction with the experts.

Two sets of questionnaire surveys were carried out to maximise interaction with the experts. In the first round, experts were asked to evaluate the priority and effectiveness of policy options. Policy packages and road maps were constructed, reflecting their first round evaluation. In the second round, the road maps were presented to the experts to explore their comments and reactions. The two-stage validation process helps the interaction with the “real world”. The inputs from the experts formed the basis for crucial modification to the road maps and contributed rich information to the research.

The consultation with the experts is not an uncommon practice in the scenario studies. For example, the IPCC's SRES study, one of the major scenario research identified by the EEA (see the Table 3.8), relies heavily on the range of experts to draw its scenarios. There is, however, generally a lack of communication between the once formulated scenarios and "the world outside of the scenarios". The novelty of the research, which took two-stage validation processes, thus lies in its effort to maximise interaction with expert "after" the scenario composition.

8.2.2.3 The Implementation Analysis

Another finding is related to an important but often neglected aspect of scenario study: the implementation analysis. Implementation analysis is a highly important element of scenario study, as it binds the scenario and its implication to the wider society. Most of the existing studies focus heavily on technical viability of reducing CO₂ emissions and tend to present the lists of potential options, without paying much attention on how much they could be carried out as a real policy actions.

Implementation analysis can point out political, economical and technical barriers, and the identification of barriers leads to the discussion of the responsibility for overcoming these barriers. Based on the communication with experts, reluctance of the government and the industry was identified as the major barrier for the road map implementation. Much detailed analysis for specific policy options can further clarify the precise strategy to carry them out. Such analysis should identify how individual options could be accepted by members of the society. Carbon tax may be, for example, agreed by the industry if that is combined with financial reward.

One important issue related to the policy implementation is how the policy is funded. The existing scenario studies (especially in Japan) are rather keen to list technological assumptions, and silent on how the technological assumptions could be financially backed. This research tries to overcome this problem by maximising the link between individual policy options and financial strategies (e.g. the reallocation of EPRDSA to support renewable development).

Also, often the existing analysis ignore the social cost, especially when the studies are primarily based on numerical modelling, and they are established on the econometric assumptions which often do not adequately address issues such as externalities. It is, however, crucial to analyse policy combination in light of social cost and benefit to assess the desirability of a Vision.

Though this research does not explicitly address the issue of social cost, it covers the policy options that are normally excluded from the CO₂ emission modelling (e.g. local government empowerment). In this way, it tries to cope with the issue associated with the conventional simulations that pay little attention to social matters. On the other hand, this research acknowledges more studies have to be conducted to identify the level of externalities. For example, as climate change

progresses, people may attach more value to the environmental protection than they do now. This kind of value fluctuation over time could lead to increased (or decreased) strength of policy actions, and that may affect the formulation of the road map.

8.2.2.4 Issues of debate and Summary of Methodological Findings

The research also faced some difficulties. Although quantitative targets were established to provide a valid perspective to each scenario, it was difficult to numerically assess the potential effectiveness of individual policy options and how they contribute to the reduction of CO₂. This was because the policy options were interconnected with each other in the road map, and some of the options have indirect effects.

Another issue was the choice of experts. The research faced a dilemma of who should be contacted and who actually replied. Some experts were willing to respond to the research, while others were not. The absence of the responses from experts who did not respond in time may have created imbalanced perspective to the questionnaire result. Also, even when they did reply, the degree of detail of the comments varied depending on the individual expert. It seems that some experts

were willing to give comments extensively to most of the topic raised, while some others preferred to do so on the issue they were specialised. Nevertheless, the experts' responses generally demonstrate remarkable similarities. Particular options (e.g. feed-in tariff for renewable development) were valued by most of the experts, while some options collectively received poor evaluation (e.g. limit the entrance of independent power producer in the market).

Therefore, despite some problems, the research is confident in a sense that it was able to formalise the methodological thinking of backcasting. So far, very little empirical research has been conducted to test the value of an anticipatory framework in scenario studies, particularly in the Japanese context. The research found backcasting methodology stimulates experts' discussions, contributes to the creation of a mental mapping to complete a future Vision and identifies the barriers that need to be overcome.

The normative nature of the methodology is particularly relevant for dealing with future uncertainties: Visioning made it possible to proactively assess the policies at the strategic level, and it reduces potential uncertainties. In this research, 30 years was chosen as a time horizon for backcasting policy analysis. This time scope would be most suitable to reflect relevant technological and other

developments. If longer, the level of uncertainty could be too great to come up with any meaningful policy conclusion, while if shorter, there would be little freedom to coordinate necessary range of actions.

8.3 Research Findings

8.3.1 Research Findings Description

The details of the four scenarios and policy packages were summarised as below.

The Vision I focuses on the options which broadly represent the business-as-usual case, entailing minimum policy changes. Most of the existing situations as to energy issues (i.e. energy industry structure) are kept as they are, with a high economic growth target. On consultation with the experts no affirmative response as to the Vision's desirability was heard. The Vision and its subsequent road map are both regarded as significantly weak for Japan to meet the global challenge.

The Vision II represents the future where Japan increasingly relies on natural gas. Policy options under Vision are selected to form a road map which would enable the transition to mass-scale gas use. This "Dash-for-Gas" Vision has clear

implications and potentials in Japan, where the large scale pipeline investment is debated.

Nonetheless, the most of experts disagree that this should be the major Vision for Japan. The main reason of their objection is the Vision's strong emphasis on supply side management. The experts consider concentrating solely on supply side issues is not sufficient to meet the targets. The opinions were also reserved due to the cost and other issues related to the pipeline construction.

The Vision III is to create a policy impetus to encourage renewable energies. Most prominent feature in the package is the strong financial support for individual/corporate renewable development. In 2003, the Japanese parliament has decided the introduction of renewable portfolio standards (RPS), rather than the feed in tariff. As the RPS could create a cap for renewables, the Parliament decision is seen by the environmentalists as a blow to the renewable development. Nevertheless, the experts generally favoured the overall direction suggested by the Vision, though some pointed out financial burdens associated with the Vision.

The Vision IV addresses the most drastic change among all the Visions, requiring large-scale energy efficiency, de-fossilisation of energy sources and

decentralisation of energy production systems. The Vision IV was generally received well by the experts. The Vision, however, does require strong governmental intervention, which raised some concerns among the experts who favour the role of government to be kept minimal. Implementation of the Vision is also considered as a problem, though some suggested a clearer explanation of individual options may help to gain public acceptance, which would ease their introduction.

8.3.2 Research Findings Discussion

8.3.2.1 Social justice and operational efficiency

Throughout the research, the strong focus was on CO₂ abatement. As the Chapter 4 identified, there are equity and efficiency targets, as well as environmental targets. The readers are specifically reminded that the research has asked the following specific question:

If the wider actors involved in the scenario construction bringing them into a strategic decision, does it have any possibility of bringing social justice and operational efficiencies, for example by reducing the local conflicts? (Chapter 1)

In the Visions II, III and IV, natural gas and renewables play significantly greater roles than have at present. This inevitably has influence on the power plant planning. For example, especially in the case of Visions III and IV, where distributed electricity generation is widely encouraged, the demand for large-scale electricity plants may be substantially reduced.

Also, the nuclear phase-out is a common element in all the Visions created in this research. This is taking the international recognition that there are a wide range of technologies available for emission reduction, including efficient conversion in production and use of energy, low greenhouse gases emitting technologies and improved land use practices (IPCC, 2002). The important point is that these technologies and practices can form a portfolio to best achieve a normative goal. It would be difficult to justify putting an expensive and high risk choice like nuclear technology into the portfolio, considering that the rich diversification of other sustainable actions is becoming available.

The nuclear phase-out brings the prospect of limiting local conflicts, currently evident in most of the areas with nuclear plant sitings. Furthermore, nuclear plant sitings have frequently become the sources of political “corruptions” which leads

to public apathy towards local politics and their alienation from participating local strategic decision-making. The adoption of the alternatives identified here could reduce these problems.

A wider public participation will certainly bring increased operational efficiency. Encouragement of embedded energy generation (as in Visions III and IV) demand the public to engage in energy generation, and such participation in energy generation is beneficial not just from a technical, but also an operational perspective, as it would inevitably increase their awareness of energy efficiency.

8.3.2.2 Regional integrity

In Vision II, as natural gas import increases, geopolitical interconnections would play a considerable role. Japan would be, for example, placed in the position to negotiate with Russia on the gas deals. As such deals get more widely available, regional geopolitics may become a more pressing issue than they currently are, and it would become the key to link Japan and its neighbouring countries both economically and politically.

In Visions III and IV, regional and national integrity is more evident, as Japan increases the share of indigenous energy accessibility through renewable energy development. This may not directly result in the reduced demand for highly controversial energy sources, such as nuclear or volatile middle-east oil, but certainly brings the possibility for less reliance on these.

Sustainable development has been often mixed up, by the Japanese policy makers and the public alike, with “recycle-based society”. The idea behind the “recycle-based society” is to encourage *material* recycling to the extent that eventually the flow will be completed within certain geographical boundaries. The sustainability element of *energy* supply and demand is often overlooked in Japan. Nevertheless, regional integrity, through energy development, is a key to sustainability, as it ultimately encourages a completed cycle that demands less resources outside of the stated ecological boundaries. In other words, a large ecological footprint is not an option, when a “very deep ecology” paradigm is sought (Chapter 2).

8.3.2.3 Macro and Micro Energy Production

The above regional integrity issue is strongly connected with the scale of energy

production. If the currently prevailing “regime” of macro energy production in the developed countries is maintained (and even expanded in the developing countries), the regional integrity is difficult to achieve. On the other hand, the technological advancement is gradually making smaller scale of energy production available, where localised energy sources, especially those which are in environmentally benign forms, are utilised. The adoption of these emerging technologies is best supported by the coordinated and consistent policy framework, as Visions III and IV strongly emphasised.

The development of micro energy production in the developed countries, including Japan, has a significant implication for the developing countries, because these technologies might be transferred to them to satisfy their basic energy needs and at the same time they should achieve environmental goals.

8.3.2.3 Political and Institutional Issues: the Government, Business and Public

Changing the course of national energy policy towards sustainability requires strong political commitment. Experience has shown that the systematic policy formulation and its rigorous implementation can make the “decoupling”¹ between

¹ De-coupling is a situation where environmental degradation reduces regardless of the

economic development and environmental performance. Denmark is appreciated, for example, by the International Energy Agency, as one of the few countries which succeeded in this perspective (IEA, 2003).

In addition to the political will, cooperation by business community is important. The business community tends to be less willing to participate in environmental actions, for good financial reasons. To establish effective policy options that are acceptable, or even favoured, by the business sector would hold the key to gain their cooperation. In this research, policy options based on economic incentives, such as emission trading, are designed to give sufficient incentives to secure the community to improve their environmental performance.

Overall, the Japanese people's awareness towards environmental issues is generally high (though their attention is sometimes restricted to the material cycle through separate collection of waste). Awareness and action are, however, different matters. In order to connect their awareness with action, adequate incentive is required. For example, the installation of solar power panels at home is getting wider attention, but that is not because of environmental concern, but because it reduces the electricity cost. Thus, the sufficient degree of financial

increased income. For the details on the definition of de-coupling, refer Chapter 4.

encouragement is highly important to trigger the public support and action.

8.4 Recommendations

Japanese energy policy has been showing some signs of change, though the gradualism, which is common in the Japanese policy formulation process, is still observable in the energy context. The absence of a clear long-term strategy seems to necessitate the establishment of an evident Vision and subsequent argument as to the best ways to achieve that Vision.

The research, which was to a great extent inspired by the backcasting analysis framework, recognises the value of the anticipatory exercise as a means to break the trend. This chapter ends with a list of recommendations both for the Japanese energy policy formulation process and for the scenario studies.

8.4.1 Policy

As mentioned above, the Japanese energy policymaking is characterised by “gradualism”, where piecemeal steps are taken without clear strategic perspective, while there is less emphasis on flexible and quick adaptation of new policies.

As an urgent action, it is necessary to map out all the relevant issues to the energy strategy. In particular, there should be a drastic change in the way LTEF is drawn, or the LTEF should be replaced with more strategic, proactive and extensive scheme. There has been a tendency in the Japanese energy policy formulation process to ignore the strong interactions among various issues. For example, electricity deregulation takes place without much reference to its environmental consequences, and environmental taxation is argued without regard to price mechanism under the energy market reformation. The narrow scoping is most evident when we look at the energy policy formulation process under the new Framework Law on Energy, as described in the box below.

The government intervention through necessary action is crucial for effective energy policy. That, for example, ultimately defines the level of market forces. Electricity pricing mechanisms which reflect the cost difference during a day may give an important signal to customers when and how they use electricity. It is the role of policy to decide if the market is liberalised enough to let the price differentiation allowed. The policies, therefore, have to be coordinated under a strategic perspective.

Box 8. 1 Framework Law on Energy

The Framework Law on Energy was approved by the Parliament on June 2002. Critics argued that the original intention of the drafting of the law was to firmly place nuclear energy into the core of the national energy policy, as well as to protect the domestic energy industry from competition with foreign market participants (Suwa, 2001).

Energetic lobbying carried out by Japanese non-governmental groups' coalition, successfully diluted some of the original intention of the law. Highly centralised nature of the law, however, remains to oblige local authorities and the public to have a duty to respect the national energy policy.

Under this law, the energy plan was drawn up in 2003. The energy plan's coverage was limited to the time period of only 10 years. The plan formally recognises the nuclear as a baseload fuel. The plan also "pledges" to protect current utility system, meaning there would be no horizontal separation of the industry.

On the other hand there is no robust and novel policy adopted by the Energy Plan aiming at sustainable energy future, which makes its existence a wasted opportunity. In order to make much "meaningful" energy plan, deeper discussion with much wider participants would be desperately required. Currently, the government committee members are selected by the ANRE. There is no clear process of selection, with some members are "favourites" of the ANRE, being the member of government committee for many years, mainly due to their highly "cooperative" attitude to the government. Members with opposite opinions to the government policy, though invited, seem to serve only cosmetic purposes.

8.4.2 Organisational Change

An energy policy solution requires wide range of issues to be coordinated. There are, however, few mechanisms to coordinate different government departments. The government committee are, for example, organised under different responsibilities. METI controls, *inter alias*, Advisory Committee for Natural Resources and Energy, as well as committees on coal mining to industrial structure. MLIT organises the Committee on Transport Policy, while MoE accommodates the Central council on Environmental Protection, the main driving force behind the environmental policy progress in Japan. All of these committees are important to cover the scope of energy strategy, but so far these committees operate on their own, under the patronage of different departments. Inter departmental committee would probably serve to bridge a wider range of issues relevant to the energy strategy.

Table 8. 1: Main committees relevant to the energy strategy

METI	General Resource Energy Committee
MLIT	Council for Transport Policy
MoE	Central council on Environmental Protection

1) Organisational merger: new institution

As a next step to the inter-departmental committee formation, departmental merger could probably bring stronger coordination. Currently, the ANRE, the only agency specifically deals with energy issues, is a subdivision of the Ministry of the Economy, Trade and Industry (METI). Due to the increasingly greater recognition that energy and environmental issues have strong interactions, there is no reason why the energy agency is controlled only by the METI: the Ministry of Environment (MoE) and other government departments should also have a larger influence on the agency. The creation of a new agency, which is assigned to have energy and environmental responsibilities, would serve to coordinate the relevant policies.

2) Local government: lack of energy expertise

The national governmental reorganisation should be in accordance with reorganisation at local level. Currently, the local government is not required to have personnel for local energy management. It is not known how much local energy development opportunity is lost. Establishing energy expertise at local government level is urgently required to coordinate necessary actions for

sustainable local energy development.

8.4.3 Methodology

Although the combination of Future studies (backcasting + scenario building) has been thus proven as an effective methodology, much more research needs to be carried out. Main methodological suggestion for future research can be summarised as follows:

1) Linking options and numerical targets

Some experts expressed their concern that they were not able to assess the effectiveness of options identified by the research, because of absence of numerical information as to their potential. The purpose of the research is to break future trends from the current trends, rather than simulate futures. Thus numerical description is not a critical element. However, numerical descriptions with potential deviation variance may become useful information to map clearer effects of identified options. If a computer based software for scenario building is developed, it would help the decision making and interactive discussions.

2) Consult a wider range of experts

The research tries to maximise interaction with experts with a variety of backgrounds. Though carefully chosen, because of the limited number, the experts' assessment may deviate in one way or another. If more experts were included, some evaluation results may vary from the one this research discovered. Therefore, wider participation of experts would be valuable to have much more rigorous collection of opinions and research results. Given the difficulty to find the experts for strategic thinking domestically, international experts could be added to the panel. The presence of the international experts could most likely bring new perspective to the policy analysis that domestic panels do not conceive.

3) Link with real policy making

One of the purposes of the research is to maximise interaction with experts so that it optimises the backcasting concept dissemination: It is to make the experts aware of the strategic framework, so that they can use the idea in the real policy making environment. For this purpose, more experts from governmental committees should have to be included in the expert group, so that their conceptual framework may have more chances to be directly reflected in the government policy

formulation process.

4) Periodic assessment

In the longer term, clear policy assessment loop has to be established. The effectiveness of individual policy options, as well as policy package and road map, should be reviewed in relative to their effectiveness to achieve a Vision by systematic policy review in a regular cycle. Generating a set of indicators may help monitoring policy progress to achieve the identified targets.

8.4.4 Further Research

Backcasting would be one of the most prominent methodologies for strategic energy policy assessment. Though many conceptual works have been done, not many empirical studies have been so far conducted to apply the methodology in a real policy context. In particular, Japanese energy studies are, as illustrated, largely based on exploratory, rather than an anticipatory framework. Their purpose is normally to prove CO₂ reduction and this is possible through various technological and other means, by using numerical simulation. The Japanese Academics need to move from these simulation style approaches to adopt more

strategic methodologies under which identification and coordination of necessary actions is possible.

Based on the above recognition, this research is aware of the key four elements to be taken into consideration upon conducting strategic research;

- 1) Imaginative
- 2) Extensive
- 3) Consistent
- 4) Interactive

- 1) Imaginative

To prescribe an imaginative future Vision, without being too unrealistic, is a very difficult task. Because of this difficulty, conservatism often prevails upon drawing such a Vision. Still, instead of gradualism, forward looking and strategic policy making in a robust manner is imperative, considering the urgency attached to the climate change issues. Care must be also taken to be imaginative in a “meaningful and realistic” way. The future Visions and relevant elements must be “reasonably” established on the information available at the moment of instigation. At the same

time, the purpose of the exercise has to be remembered all the time, that is “*to break the trend*” by proposing an alternative (better) future.

2) Extensive

The alternative future is best achieved through extensive areas of policy interactions, including economic, social, technological and other categories. Fragmented division of academic disciplines often pays attention to particular aspect of problem but does not take a more holistic approach. For example, a technology-oriented scenario study often overlooks the socially and economically necessary arrangements, such as roles of electricity market reorganisation and local government restructuring that makes the technology available in the market. Instead of single discipline, an extensive interdisciplinary approach is required to formulate balanced policy packages between social and environmental priorities with the more conventional economic arguments.

3) Consistent

In order to break the trend, the normative scenario study has to be imaginative. At the same time, a future Vision and the subsequent policy tools, such as policy

packages and road maps, have to be consistent. To link all the possible policy options and packages is a daunting task, but attempts should be made to achieve consistency that connects the future Visions and the road maps. Also, consistency between options from different categories should be in place. It means synergetic effects among individual policy options has to be created.

4) Interactive

The anticipatory scenario study should not be a “one-off” exercise present “likely” future. Once created, the scenario has to be presented to wider audience to start a dialogue. It is always a part of dissemination, as well as learning, processes for making a “better” scenario. The whole process has to be open, flexible and interactive. In other words, adaptability is a key to respond the demand from the audiences, while it has to maintain sufficient robustness to “break the trend”.

This research recommends the further researches to be conducted to enhance the above elements. For example, the interactivity can be improved through discussions and dialogues with key policy makers, academics and the public. Also, in depth research can be organised to identify specific policy option’s viability.

8.5 The Final Word

Energy is the driving force behind human activities. There is growing concern, however, that the current level and form of energy use conflict with the sustainability of the earth ecosystem. The use of fossil fuels and subsequent increase of CO₂ emission are the main causes of global climate change. Innovative policies and the framework to develop and coordinate those policies in strategic manner are required to avoid an anticipated “unsustainable” future. Instead of a piecemeal, gradualist approach, forward looking and strategic policy making has a great advantage to evade the anticipated catastrophe, by presenting a clear sense of alternative directions.

This study took the challenge to formulate a future Vision and to identify the necessary policy options in the Japanese context. This research recognised its initial purpose has been fulfilled through the whole exercise. At the same time, it urges the policy makers and researchers to respond to the issues raised in this research, notably the role of scenario and implication of backcasting methodology in a national energy policy context.

Time may not be left much, as critics believe Japanese energy policy made during

the first decade of 21st century has significant implications to its mid to long term environmental performances. Many of its power plants, for example, are becoming obsolete. Decisions on the power plant replacement planning inevitably have a strong influence on Japan's prospects for meeting the international climate obligations, not only for the first commitment period defined under the UNFCCC, but also for much longer time scale. Policy actions *have to* be taken with those longer term impacts in mind, and research must contribute to guide such actions. That is the duty of us for the future generations and the reason for this research to be carried out.

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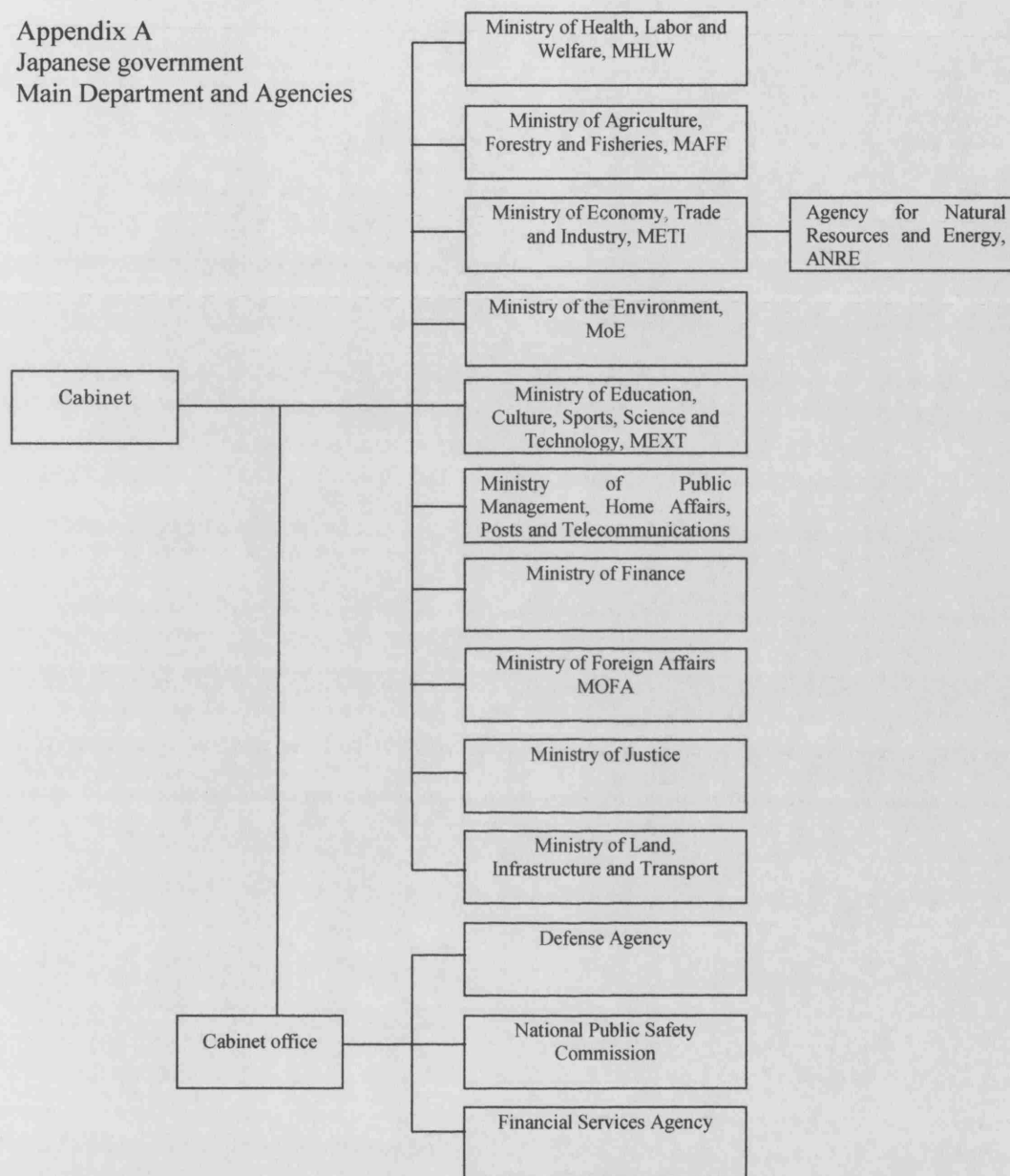
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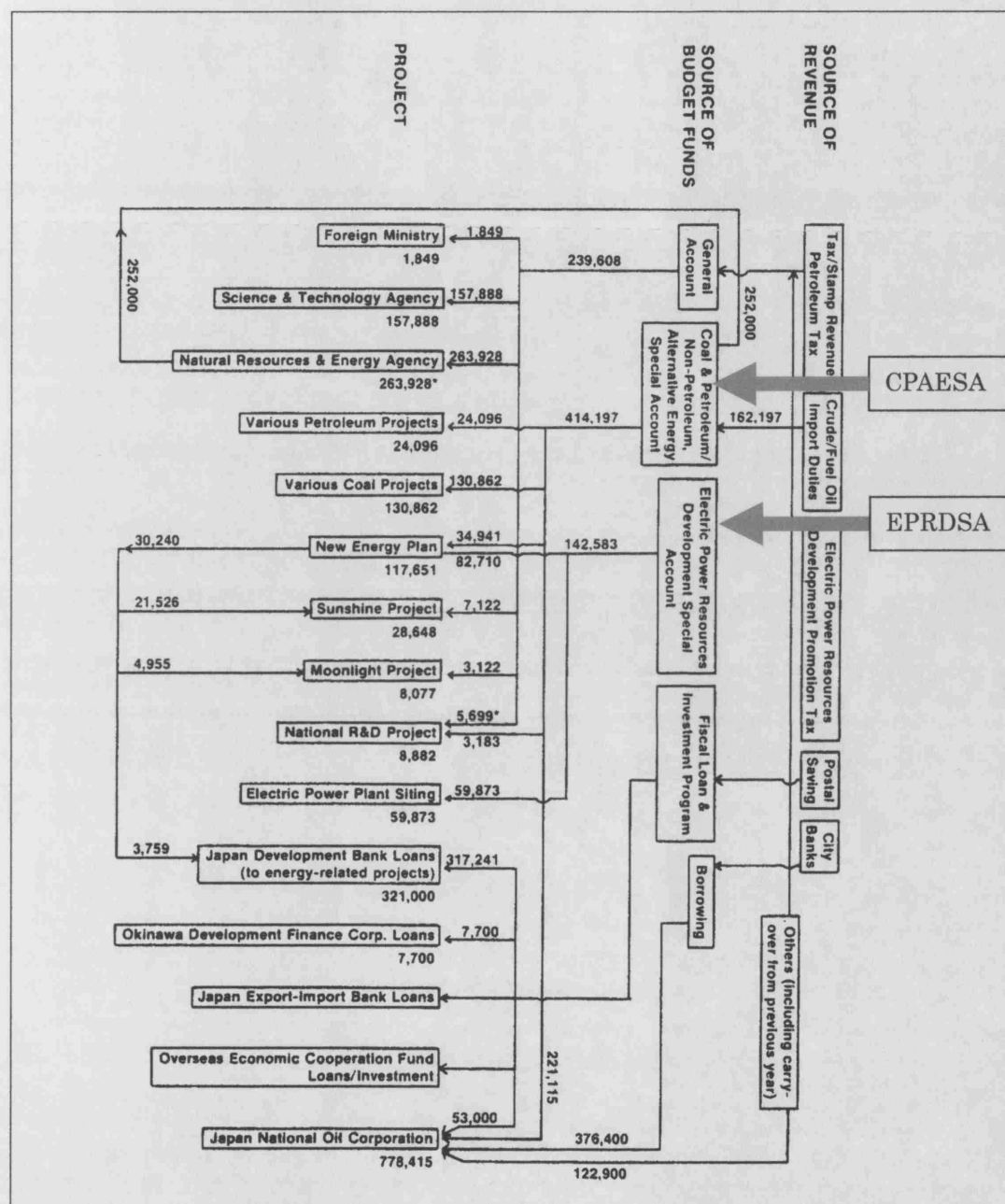
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Appendix A
Japanese government
Main Department and Agencies



Appendix B: Energy-Based Budget (Fiscal 1980) (in millions of yen)



(Source: Japan Petroleum and Energy Weekly, 1980 in Suttmeier, 1981)

Appendix C

Appendix C: Energy Calculation

Primary supply (kloe)

	1999	Vision I	Vision II	Vision III	Vision IV
Coal	103,068,819	98,900,985	45,878,641	50,250,011	40,707,753
Oil	308,401,992	311,211,118	245,623,573	228,436,531	199,725,559
LNG	75,417,501	102,661,617	158,172,261	126,425,044	99,969,030
Hydro	21,484,835	11,551,892	10,663,285	11,551,892	9,774,678
Nuclear	77,028,594	40,140,965	40,140,965	40,140,965	40,140,965
Others	7,837,045	25,499,000	21,297,000	28,694,800	22,032,400
New Energy Thermal	6,774,000	20,042,000	15,840,000	10,564,800	10,344,400
New Energy Non-thermal	1,063,045	5,457,000	5,457,000	18,130,000	11,688,000
Depretion of stock	-15,711,934	0	0	0	0
Total	577,526,851	589,965,577	521,775,725	485,499,243	412,350,385

Appendix C

Final demand (by fuel) (kloe)

	1999	Vision I	Vision II	Vision III	Vision IV
Coal	43,246,475	43,246,475	38,921,827	34,597,180	30,272,532
Oil	241,014,002	265,115,402	241,014,002	216,912,602	192,811,201
LNG	448,727	493,600	538,472	538,472	538,472
Town Gas	25,537,435	28,091,178	30,644,922	30,644,922	30,644,922
New Energy Heat/Thermal	4,614,000	4,614,000	9,228,000	4,614,000	4,614,000
New Energy Heat/non-Thermal	1,021,000	5,105,000	5,105,000	10,210,000	8,168,000
Electricity	87,652,071	113,947,693	96,417,278	96,417,278	70,121,657
Hydro	8,886,071	11,551,892	10,663,285	11,551,892	9,774,678
Thermal	60,474,037	87,687,353	72,568,844	66,521,441	48,379,229
Coal	13,461,435	21,538,296	2,692,287	6,057,646	4,038,430
Oil	8,919,521	17,839,042	1,783,904	4,459,761	2,675,856
LNG	20,476,955	28,667,737	49,144,691	36,858,518	26,620,041
Autoproducers	17,616,126	19,377,739	19,377,739	19,377,739	15,854,514
Sub total	60,474,037	87,422,813	72,998,621	66,753,664	49,188,842
Nuclear	29,436,708	13,246,518	13,246,518	13,246,518	13,246,518
New Energy Power	916,800	5,500,800	2,750,400	5,500,800	3,667,200
Thermal	881,600	6,171,200	2,644,800	2,380,320	2,292,160
Non-thermal	35,200	140,800	140,800	3,168,000	1,408,000
Others total	916,800	6,312,000	2,785,600	5,548,320	3,700,160
Sub Total	99,121,198	117,986,564	99,229,048	96,820,651	75,067,626
Others	4,213,709	4,213,709	4,213,709	4,213,709	4,213,709
Total	407,747,419	464,827,057	426,083,211	398,148,163	341,384,494

Final demand (by sector) (kloe)

	1999	Vision I	Vision II	Vision III	Vision IV
Industry	193,829,762	213,212,739	174,446,786	174,446,786	155,063,810
Household	56,431,762	62,074,939	62,074,939	55,867,445	44,693,956
Commercial	49,542,710	54,496,981	49,542,710	44,588,439	39,634,168
Transport	100,169,934	120,203,921	110,186,927	100,169,934	80,135,947
Others	7,773,250	7,773,250	7,773,250	7,773,250	7,773,250
Total	407,747,419	457,761,829	404,024,612	382,845,854	327,301,131

Appendix C

CO2 emission volume (ton-CO2)

	1999	Vision I	Vision II	Vision III	Vision IV	1990
Coal	359,183,496	344,659,055	160,958,557	176,294,874	142,817,246	306,338,598
Oil	835,914,347	843,528,399	665,755,327	619,170,363	541,350,135	831,037,579
LNG	146,012,053	198,758,023	306,229,405	244,765,207	193,545,041	103,170,770
Total	1,341,109,897	1,386,945,477	1,132,943,289	1,040,230,443	877,712,423	1,240,546,947

Appendix D: List of Respondents

First Round

Category	Name	Background
Government	Dr. M. Utagawa	Researcher National Institute for Resources and Environment (NIRE), MITI
Industry	Mr. T. Shoda	President Japan Natural Energy Company Ltd.
	Dr. T. Suzuki	Senior Research Scientist Central Research Institute of Electric Power Industry
	Mr. Y. Santoh	Executive Advisor Research Institute of Culture, Energy and Life Osaka Gas
Consultants, Private Research Institute	Mr. T. Iida	Director Institute for Sustainable Energy Policies
	Mr. T. Ikuta	Senior Associate Fujitsu Research Institute
	Mr. Y. Soda	Researcher Japan Science and Technology Corporation
NGO	Mr. N. Hata	Researcher Kiko Network
	Mr. T. Katsuta	Researcher Citizens' Nuclear Information Center
Academics	Prof. K. Ueta	Professor Kyoto University, Faculty of Economics
	Prof. Dr. K. Yamaji	Professor Tokyo University, Department of Electrical Engineering

Second Round

Category	Name	Background
Government	Mr. M. Utagawa	Researcher National Institute for Resources and Environment (NIRE), MITI
Industry	Mr. T. Shoda	President Japan Natural Energy Company Ltd.
	Dr. T. Suzuki	Senior Research Scientist Central Research Institute of Electric Power Industry
	Mr. Y. Santoh	Executive Advisor Research Institute of Culture, Energy and Life Osaka Gas
Consultants, Private Research Institute	Mr. T. Ikuta	Senior Associate Fujitsu Research Institute
	Mr. Y. Soda	Researcher Japan Science and Technology Corporation
	Ms. N. Hiraishi	Researcher, Mitsubishi Research Institute
	Mr. K. Motohashi	Editor, Energy Forum Magazine
NGO	Mr. T. Katsuta	Researcher Citizens' Nuclear Information Center
Academics	Mr. M. Uezono	Assistant Professor Shimane University
	Dr. Y. Itoh	Assistant Professor Chiba University of Commerce

Appendix E: Summary of the whole options

Vision I		Vision II		Vision III		Vision IV	
Supply-1	Increase of mini hydro	Supply-1	Increase of mini hydro	Supply-1	Increase of mini hydro	Supply-1	Increase of mini hydro
Supply-2	Abolition of nuclear power	Supply-2	Abolition of nuclear power	Supply-2	Abolition of nuclear power	Supply-2	Abolition of nuclear power
		Supply-3	Convert coal power station into gas use				
		Supply-4	Advanced gas power technology				
		Supply-5	Define gas as a baseload fuel				
		Supply-6	Improve power production efficiency				
				Supply-7	Fuel cells for transport	Supply-7	Fuel cells for transport
				Supply-8	Feed-in tariff	Supply-8	Feed-in tariff
				Supply-9	Renewable investment	Supply-9	Renewable investment
						Supply-10	Heat strategy
						Supply-11	Biomass electricity
						Supply-12	Baseload change
		Infrastructure-1	To construct			Infrastructure-1	To construct international

		international and domestic gas pipeline			and domestic gas pipeline
		Infrastructure-2 increase CHP			Infrastructure-2 increase CHP
				Infrastructure-3 Priority connection to RES	Infrastructure-3 Priority connection to RES
				Infrastructure-4 Offshore RES	
				Infrastructure-5 Foreign RES	
				Infrastructure-6 RES obligation for buildings	
				Infrastructure-7 Import RES	
					Infrastructure-8 Electricity storage
					Infrastructure-9 High voltage transmission
					Infrastructure-10 Tele-commuting
Market-1	Domestic CO2 permit trade	Market-1 Domestic CO2 permit trade	Market-1 Domestic CO2 permit trade	Market-1 Domestic CO2 permit trade	Market-1 Domestic CO2 permit trade
Market-2	Modify electricity price menu	Market-2 Modify electricity price menu	Market-2 Modify electricity price menu	Market-2 Modify electricity price menu	Market-2 Modify electricity price menu
		Market-3 MGT			
		Market-4 Increase competition between gas and electricity industry			

	Market-5	liberalise gas industry			
	Market-6	Connect gas uses with pipeline			
			Market-7	Horizontal split of elec market	Horizontal split of elec market
			Market-8	Green certificate trade	Green certificate trade
			Market-9	RPS	
					Market-10
					Liberalisation of energy production
					Market-11
					Combine green certificate and CO2 permit
					Market-12
					Direct negotiation between customers and elec supplier
					Market-13
					On-site energy de-Regulatory
					Market-14
					Gas-direct negotiation
Financial-1	EPRDSA		Financial-1	EPRDSA	EPRDSA
Financial-2	Coal tax		Financial-2	Coal tax	Coal tax
			Financial-3	Reallocate petroleum budget	Reallocate petroleum budget

	Financial-4	Finance pipeline by ODA		
			Financial-5	General budget to RES and energy efficiency
			Financial-6	Carbon tax
			Financial-7	Thermal equipment
			Financial-8	Green certificate purchase
			Financial-9	On-site energy production
			Financial-10	Tax for car
			Financial-11	Virgin material tax
Regulatory-1	CO2 consideration in EIA	Regulatory-1	CO2 consideration in EIA	Regulatory-1
Regulatory-2	Restrict IPP's fuel choice	Regulatory-2	Restrict IPP's fuel choice	Regulatory-2
Regulatory-3	Restrict IPP's market entrance	Regulatory-2	Restrict IPP's market entrance	Regulatory-2
		Regulatory-4	Vehicle efficiency standard	Regulatory-4
				Regulatory-5

			Regulatory-6	Building efficiency
			Regulatory-7	Penalty for non-efficiency
			Regulatory-8	Coal gasification
			Regulatory-9	Renewable equipment on new building
			Regulatory-10	Limit elec production
		Land use-1	Land use Regulatory	Land use Regulatory
			Land use-2	Transport policy
			Land use-3	Lorry sharing scheme
			Land use-4	Transport demand management
			Land use-5	Public transport in metropolitan area
			Land use-6	Quality of public transport
			Land use-7	Inter-port logistics
			Land use-8	Fleet railway
			Land use-9	Parking space Regulatory
			Land use-10	Renewable restriction
			Cross sectional-1	Recycled materials
			Cross sectional-2	Biomass waste

				Cross sectional-3	Reduce petrochemical products
				Cross sectional-4	Energy crop
				Social-1	RES procurement
				Social-2	Energy forecast
				Social-3	Political decentralization
				Social-4	Local energy plan
				Social-5	Independent institution for energy efficiency
				Social-6	employment
				Social-7	Reduce public spending
Information-1	Product labeling	Information-1	Product labeling	Information-1	Product labeling
Information-2	PRTR	Information-2	PRTR	Information-2	PRTR

Appendix F: Expert Comments (Round Two)

Vision I

	Utagawa (Gov1)	Santoh (Ind1)	Shoda (Ind2)	Suzuki (Ind3)
1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?	<p>The idea of making road map is good, as it visually describes the overall image of what to do. It is commendable to distinguish those policy options that directly have impact to reduce CO2 emissions and those which support the direct options.</p> <p>The sufficiency of options to achieve this vision is adequate, but the objective of the vision itself is too less aggressive.</p> <p>Domestic CO2 permit trade should be packaged with policies which would give sufficient incentive to make the trading effective, e.g. tax or levy.</p> <p>Environmental impact assessment for power stations should consider CO2 emission volume. The CO2 efficiency of natural gas power station should be established as the best available technology for thermal power stations.</p> <p>The increase of oil power production has to be carefully considered in line with the IEA policy which restricts Japan to increase its oil power production capacity.</p>	Only manipulating some systems is not sufficient.	<p>"Increase of mini hydro power production" is a target, rather than policy option. It is important to clarify what kind of options can make this target achievable.</p> <p>Same comment to the "change of electricity price menu": It is a target, therefore, the issues which can make this happen have to be discussed. For example, the nature of policy can greatly vary depending on whether this can be done as part of de-regulation, or by imposition of price regulation.</p>	<p>The overall emphasis of the vision is questionable. It only emphasises the supply-side issue: the demand-side aspects should be more taken into consideration, especially those related to transport and domestic sectors.</p> <p>For the achievement of the Kyoto target, more stringent policy options are required. It is also not clear if the nuclear share is really going to be reduced to the level specified by the road map. Especially for the carbon tax and emission trading, earlier preparation for their introduction should be considered.</p>
2. Do you consider the timing of option implementation is appropriate?	<p>"Information strategies" should be introduced earlier than introduced.</p> <p>"Electricity price menu change" and "CO2 consideration in environmental impact</p>	"Electricity price menu change" should be done earlier than indicated.		"Electricity price menu change" can be introduced earlier than indicated, given the situation in Japan where a series of electricity liberalisation actions are taking place.

	assessment" can be introduced earlier: they are feasible at least technically, if not politically. CO2 consideration in EIA is an urgent issue, in the situation where nearly 20 coal power stations are under construction or planning.			The reformation of EPRDSA should be extended to the reformation of special accounts as a whole.
3. What would be the barriers for option implementation?	<p><u>Carbon tax</u> Industries will strongly against the introduction of carbon tax, whereas consumer organisations are favour of the tax. The introduction of carbon tax itself may not be effective to reduce CO2 emissions, but it can trigger the introduction of other options.</p> <p><u>Domestic carbon trade</u> Industry severely against the idea. Initial allocation of the permit can be difficult to be decided. Supplemental policies are necessary to avoid domestic "hot air" trade.</p>	The position of nuclear in the energy portfolio must be controversial		<p>Currently, how to harmonise liberalisation and CO2 reduction is a key issue. It is not clear whether and how this issue is defined under the vision.</p> <p>It is questionable whether mini-hydro powers should/can be increased.</p>
4. Do you think if a vision and policy package is desirable? Or easy to implement?	<p>Easy to implement. But not desirable as the CO2 emission volume in 2030 increases.</p>	There would be strong oppositions from electricity industry.		Relatively easy to implement
5. Do you think, for a vision and policy package, social and economical cost is large or not?	Social cost would be high. Also economic cost would be high, as it relies on the Kyoto mechanisms.	There would be little cost for achieving this vision.		There would be not much cost required.

Vision I (Continued)

	Hiraishi (Cons1)	Ikuta (Cons2)	Motohashi (Cons3)	Souda (Cons4)
1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?	<p>Tax payer's contribution and reward need consistency. For example, electricity customers bear the EPRDSA, and they should be benefited by the renewable development, if the EPRDSA is allocated to fund it.</p> <p>The special accounts would be better demolished and integrated into the general budget, so that they can be more flexibly used.</p>	<p>As I understand the Vision I is a BAU case, it is difficult to evaluate the policy options within this vision framework.</p> <p>I suppose the options are sufficient. However, whether "sufficient" options are available and whether "effective" options are chosen, are two different issues. For example, the domestic CO₂ permits trading, which may be economically efficient, would not be an effective option to reduce CO₂ emission.</p>	<p>In theory, the EPRDSA should be demolished for the achievement of the Vision I, of which emphasis is not on the development of further electricity sources.</p> <p>On the other hand, there is an ever-increasing demand to reform energy-related taxes. Thus the EPRDSA can remain, as long as its purpose is changed to support renewable electricity.</p> <p>It would be necessary to reform the Petroleum Account, as well as EPRDSA. In general, those accounts are getting losing their "raison-d'être".</p> <p>It would be appropriate to introduce the domestic CO₂ permit trade by 2005.</p>	<p>It would be probably possible to achieve the targets.</p> <p>The industrial structure will be more service oriented (up to 70% of the total share). Population will be decreased by 10%. Those elements will affect the overall energy demand.</p> <p>It would be possible to reallocate EPRDSA and other taxes to support renewable energy. But the new tax such as carbon tax may be easier to be used to support the renewables while the existing tax systems including EPRDSA are kept as they are.</p> <p>Earmarking may be difficult.</p> <p>CO₂ labelling must be very difficult to implement. PRTR must be easier than CO₂ labelling.</p>
2. Do you consider the timing of option implementation is appropriate?	<p>Electricity price menu change should be introduced much earlier, as it can be done through rather simple deregulation (easier than more costly option, e.g. pipeline construction).</p> <p>It would be difficult to establish fair and transparent rules for the domestic CO₂ permit trade.</p>	<p>It is questionable the timing of introducing some of the intermediate and long-term options. Especially, increase of mini-hydro power, domestic CO₂ permit trade, CO₂ consideration in EIA should be introduced earlier than indicated.</p> <p>Financial reform, which inevitably involves political arguments, would face a strong opposition (especially the EPRDSA reform). The other financial reform than EPRDSA may be possible in intermediate time-scale.</p>	<p>Electricity price menu change should be remained in the hands of market. Rather than artificially change the electricity price menu through regulations, it is more important to enable consumers to access off-demand electricity. This can be considered as an intermediate option.</p> <p>Electricity industry horizontal split identified in Vision III, may have to be introduced in Vision I.</p>	<p>Industrial opposition and politicians with vested interests would be the strongest barrier.</p> <p>Mini-hydro could cause environmental problems, if their sizes are too large.</p> <p>The electricity price menu change will proceed as the market liberalisation goes.</p>
3. What would be the barriers for option implementation?				

4. Do you think if a vision and policy package is desirable? Or easy to implement?	Relatively easier than the other Visions.	It is not desirable vision. Easy to implement, except the financial options.	More options are necessary.	<p>The overall direction is desirable, though the degree of strength to achieve the targets is too weak.</p> <p>CO₂ information disclosure in environmental impact assessment can be integrated with other information strategies.</p> <p>The social costs are small, except for regulatory and information strategies.</p>
5. Do you think, for a vision and policy package, social and economical cost is large or not?	The cost would be relatively small.	Social and economic costs would be unnoticeably small.	<p>Cost of implementation is small, except for the CO₂ labelling option.</p> <p>The design of the domestic CO₂ permit trading needs more consideration.</p>	

Vision I (Continued)

	Ito (Ac1)	Uezono (Ac2)	Katsuta (NGO1)
1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?		It would be better to include the industrial agreement as part of national global warming actions.	It is not clear why mini-hydro was chosen to be developed.
2. Do you consider the timing of option implementation is appropriate?	PRTR can be introduced much earlier.	It would take much time and effort to reform the EPRDSA, though it depends how far it is "reformed".	CO2 permit trading requires some trial period to test its implementation.
3. What would be the barriers for option implementation?	There would be strong opposition to the EPRDSA reallocation.	There would be a very strong opposition from electricity industry for the EPRDSA reform.	Information options are very important, and these costs for these purposes also require financial support. At the same time, it may be necessary to put more different information options over time.
4. Do you think if a vision and policy package is desirable? Or easy to implement?		As the linkage between overall target and individual target is not clear , it is impossible to evaluate desirability and feasibility of the policy package.	The desirability is questionable , as it does not specify the degree of energy efficiency actions.
5. Do you think, for a vision and policy package, social and economical cost is large or not?		Does the "social and economic costs" mean opportunity cost or administrative cost? The " social cost " defined Piguet would be reduced through the implementation of the suggested options.	The cost is small , in relative to the other visions.

Vision II

	Utagawa (Govt)	Santoh (Ind1)	Shoda (Ind2)	Suzuki (Ind3)
1. Do you think the policy options are sufficient to achieve the target. If not, what policy options would you suggest to cover?	<p>It is questionable if energy supply strategy, which is given a great emphasis under the vision, is sufficient. In case of more natural gas is introduced (no matter if that is through pipeline or not), the question of who actually use the gas needs consideration. (The industrial sector automatically assumes that electricity sector uses the gas, but they can also use the gas, as in some European countries. Also, residential sector should also use gas more than the current level.</p> <p>There need options to do something for the ever-increasing share of coal.</p> <p>Demand side management for transport (and residential) sector is absent in the road map.</p>		It would be technically difficult to simply convert coal power station to gas use. The fuel switch has to be done not as a short-term action, but an intermediate action involving scrapping obsolete power stations and building new power stations.	Electricity sector's demand for gas is not sufficient to make the gas pipeline project cost-effective. Large increase of co-generation, through town planning (which requires LNG vehicles, hybrid vehicles and wider availability of gas-to-liquid scheme) are required.
2. Do you consider the timing of option implementation is appropriate?		CHP, MGT can be introduced as the similar timing with IGCC.		As is in the Vision I, electricity price menu change can be introduced earlier than indicated.
3. What would be the barriers for option implementation?	<p>On gas pipeline, there would be strong opposition from parliament members who have vested interest in oil industry, as well as the oil industry itself.</p> <p>Once the financial support is ready, the construction of pipeline would be possible, though the doing business with Russia may involve some tough negotiations.</p> <p>In order for gas to be replaced with coal, tax</p>	<p>It is questionable who would take the initiative to develop gas pipeline.</p> <p>Fuel switch from coal to gas can increase the energy cost, which may cause a opposition from energy users. Also, it can raise the issue of international trade.</p>		<p>For the gas pipeline construction, the consensus within gas industry is necessary, which has been proved to be difficult to see so far.</p> <p>Revision of safety regulation on gas pipeline is also required.</p>

	<p>on coal is necessary, as well as pipeline construction.</p> <p>Coal tax would meet oppositions from industry. The effect of coal tax itself may be limited, thus the combination of the tax and other options may be required.</p> <p>On the domestic CO2 permission trade, how to define initial quota would be controversial. Also, this option needs a mechanism to prevent the domestic "hot air" trading.</p> <p>The overall objective (to reduce CO2 by 9% against the 1990 level) is too weak.</p>				
4. Do you think if a vision and policy package is desirable? Or easy to implement?		Constructing over-the-land pipeline is highly difficult.		Wider use of LNG is not the issue that should be considered solely from the Japanese perspective. It requires a wider scope, for example, it should be regarded as an "Asian" issue.	
5. Do you think, for a vision and policy package, and social and economical cost is large or not?	<p>The cost of pipeline construction would be a considerable amount. However, if (only if) the currently available estimate (4 trillion yen) is correct, it "may" be cost effective.</p>	Economical cost would be high, pushed by the cost of pipeline.		The cost of pipeline can be a considerable sum.	

Vision II (Continued)

Vision II (Continued)	Hiraishi (Cons1)	Ikuta (Cons2)	Motohashi (Cons3)	Souda (Cons4)
<p>1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?</p>	<p>Pipeline construction is very important, and needs the earliest possible implementation.</p> <p>For the demand creation of gas, gas market deregulation is damaging, as the competition within the industry could undermines their overall strength.</p> <p>The domestic gas pipeline is prerequisite for the gas market liberalisation.</p> <p>For gas to be competitive, there has to be a tax on coal, to ensure the level playing field.</p> <p>To reduce the cost of imported natural gas, Japan has to have a strong bargaining power. The pipeline can widen the customer number in Japan which is beneficial for establishing such power.</p>	<p>If this vision is achieved, the primary energy supply share change would be possible. On the other hand, as the demand management options are virtually absent, it may be difficult to achieve the decrease of the total primary energy, as indicated.</p>	<p>Under the situation where energy demand is saturated, IGCC may not be cost-effective, compared to coal gasification. IGCC may be suitable for technology transfer.</p> <p>Coal tax may be much more effective than carbon tax.</p> <p>Fuel switch is necessary not only in the electricity sector, but also in some other sectors, such as transport.</p>	<p>It would be achievable, as the external elements (economy level, population etc.) define.</p>
<p>2. Do you consider the timing of option implementation is appropriate?</p>		<p>There are many options (especially on supply side options) which may be introduced earlier than indicated. The options related to gas pipeline is considered to be appropriate.</p>	<p>Gas cogeneration should be regarded as an intermediate option.</p>	<p>For the large scale heat utilisation in Japan, very strong demand creation and drastic technological development are necessary. It would be impossible to develop such demand and technology by 2010.</p> <p>IGCC is generally supposed to be commercially available around 2020.</p>

					MGT increase should start earlier.
					The competition between electricity and gas industry has already started. The competition among gas companies would be delayed as there is no sufficient infrastructure, such as pipeline.
3. What would be the barriers for option implementation?	For the gas pipeline development, land acquisition is very important. In Japan, it is most economical to bury the lines under the motorway. A necessary arrangement has to be established with the Ministry of Transport.	Gas pipeline requires land acquisition, which may be costly and time-consuming.	The cost for converting power stations from coal to gas use.		Fuel switch from coal to gas is not desirable from energy security perspective . If Japan rely too much on gas, it will lose its bargaining power on fuel purchase negotiation. The Japanese coal technology is efficient, and it should transfer the relevant technology to developing countries.
					The government and industry are reluctant on domestic gas pipeline development because of its cost.
					Energy related taxes should be funded in general budget, then allocated to specific purposes.
4. Do you think if a vision and policy package is desirable? Or easy to implement?	It is desirable , though difficult to implement. Demand creation is the key for the road map implementation. As well as cogeneration, natural gas vehicles and fuel cells cars have to be widely available so that it could push the demand for natural gas.	It is not very desirable , as it only focuses on supply side issues. Also, this vision relies on gas pipeline construction, which may be difficult to be materialised. Thus it is not very easy to implement .	Fuel switch to natural gas must be relatively easily done. It is not desirable , however, to leave the current demand level which requires an extraordinary amount of energy.		Not desirable , as it would affect Japanese energy security. Market strategies would be easy as it is in line with the government plan for market liberalisation.
5. Do you think, for	The gas pipeline cost would be high,	Social and economical cost arising	Fuel switch would take a large amount		The economic cost is high, because of

a vision and policy package, social and economical cost is large or not?	but its benefit may surpass the cost.	from gas pipeline is high.	of cost. The cost of the pipeline can be offset by the advantage arising from having gas pipeline as a national security measure.	pipeline. But construction industry will like it. The social cost is high, if the Japanese coal technology is lost.
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Vision II (Continued)

Vision II (Continued)	Ito (Acd1)	Uezono (Acd2)	Katsuta (NGO1)
1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?		<p>It would be better to include the industrial agreement as part of national global warming actions.</p> <p>Also, for the domestic emission trade, it is necessary to impose a rule to link the eligibility for the trade with their commitment to the government-industry agreement to reduce emissions, like in the UK.</p>	
2. Do you consider the timing of option implementation is appropriate?	<p>Carbon tax should be implemented in early stage. At least, there should be tax on coal. The coal tax level should be as same with petrol.</p> <p>PRTR can be introduced much earlier.</p>	<p>It would take much time and effort to reform the EPRDSA, though it depends how far it is "reformed".</p>	<p>It would probably necessary to introduce carbon tax earlier, so that it triggers fuel switch.</p>
3. What would be the barriers for option implementation?	<p>There would be strong opposition to the EPRDSA reallocation.</p>	<p>The combination of carbon tax and domestic CO2 emission trade must invoke industrial opposition, as double regulations.</p> <p>Also, for the carbon tax would meet strong opposition from industry, though it may depend on the tax rate and how purpose of the tax is defined</p>	
4. Do you think if a vision and policy package is desirable? Or easy to implement?			<p>Fuel switch is desirable. The vision, however, is weak in energy efficiency measures.</p>
5. Do you think, for a vision and policy package, social and			<p>Social and economic cost of the vision depends on the scale of gas pipeline constructed (e.g. whether it include international or domestic pipeline).</p>

economical cost is large or not?				
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Vision III

	Utagawa (Gov1)	Santoh (Ind1)	Shoda (Ind2)	Suzuki (Ind3)
<p>1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?</p>	<p>The options under this vision have a range of energy efficiency measures, as well as renewable energy options.</p> <p>There should be more options for the ever-increasing coal use.</p> <p>More options for transport and residential sectors should be in place.</p> <p><u>Intermediate options</u></p> <ul style="list-style-type: none"> • Fuel cells should not be considered as renewable energy. • Hybrid vehicles are not the only efficient cars. Some cars of Honda and Mitsubishi have achieved the similar efficiency level with the hybrid vehicles. 	<p>Priority access should be given not only to renewable energies, but also to CHP and fuel cells.</p> <p>Technical obstacles must be reduced for these energies to be accessed to the grid</p> <p>Fuel cells for domestic sectors should be included as an option.</p> <p>Also, horizontal split of gas industry is necessary.</p>	<p>Fuel cells and hybrid vehicles are parts of energy efficiency measures, but not kinds of renewable energy. Therefore they should be dealt with in the Vision III, rather than Vision II.</p> <p>As quantified information is absent, it is difficult to comment in details, but it seems to be overestimation to reduce 25% CO2 compared to the Vision I only through increase of renewable energy.</p> <p>"Purchase of renewable energy to be legally recognised" (as part of green procurement) should be added as a relevant option.</p> <p>It is not clear whether the support for foreign renewable capacity is linked to domestic CO2 reduction.</p>	<p>Support for the local authorities to take up renewable energy development.</p>
<p><u>Intermediate options</u></p> <p>The horizontal separation is not the only way to make the electricity price setting procedure transparent. Financial reformation and other means are also required for that purpose.</p> <p>For energy efficiency, low-grade heat utilisation would be effective as an intermediate option.</p> <p>The lifespan of Japanese architecture is too short, pushing the demand for construction raw materials, (which require energy).</p>				

	Options for making buildings last long may be necessary. <u>Long term options</u> Some Asian countries like China and India are introducing a number of renewable energy schemes, with the support from European countries. Japan can and should do more for contributing to these countries.			
2. Do you consider the timing of option implementation is appropriate?				Electricity price menu change can be introduced earlier than indicated.
3. What would be the barriers for option implementation?	Options to increase renewable share, e.g. feed in tariff and carbon tax, would meet strong opposition from industry. In order for gas to be replaced with coal, tax on coal is necessary, as well as pipelines construction. Coal tax would meet oppositions from industry. The effect of coal tax itself may be limited, thus the combination of the tax and other options may be required. On the domestic CO2 permission trade, how to define initial quota would be controversial. Also, this option needs a mechanism to prevent the domestic "hot air" trading.			Increase of renewable energy in the field outside of electricity has to be discussed. Hybrid or fuel cells vehicle do not lead to the increase of renewable energy.
4. Do you think if a vision and policy	Desirable	Desirable, but the social consensus is required for the implementation.		Implementation can be tricky.

package is desirable? Or easy to implement?				
5. Do you think, for a vision and policy package, social and economical cost is large or not?	The administrative and economic cost must not be so large. The social cost is undeniably small.	The cost must not be so large.		The cost must be large.

Vision III (Continued)

1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?	Hiraishi (Cons1)	Ikuta (Cons2)	Motohashi (Cons3)	Souda (Cons4)
	For the renewable development, strong policy intervention, through e.g. feed in tariff, is important.	If these options are really implemented, the achievement of objective would be possible.	As is in the Vision I, the petroleum account also needs revision. For the increase of wind power, the issues of grid capacity needs serious consideration (e.g. grid connection between Hokkaido and the mainland Japan.)	As in the Vision I and II, if all the options are in place, the target achievement would be possible, though some of the options require very strong government intervention.
2. Do you consider the timing of option implementation is appropriate?		Increase of mini-hydro power production, the support of foreign renewable energy production can be implemented earlier than indicated (though foreign renewable support seems to have little contribution to the domestic CO2 reduction).	The option to support foreign renewable capacity increase can be introduced earlier than indicated. The support can be carried out primarily by private funding through the clean development mechanisms (CDM). International harmonisation of tradable green certificate is key to the early introduction of certificate, as it would be easier to persuade industry to obtain cheap supply of renewables.	Support for foreign renewable energy development should start earlier, as it can be linked with CDM. CO2 labelling is too early, as the industry's readiness is not matured.
3. What would be the barriers for option implementation?	International framework for renewable energy development is important, so that countries which uses renewables do not lost its market competitiveness.	The feed in tariff is difficult to be introduced in the current political and other environment. Carbon tax may be delayed to be in place (2005 at earliest?)	A great care is required that the renewables are not used to excuse any land use regulation change. Instead of carbon tax, (domestic?) CO2 permit trade of the energy production industry should be discussed.	Hybrid cars not selling much in Japan because of their design. The design of the cars should be improved to increase their market penetration. It would not be too much to give priority to renewable for grid connection, as long as they are supported by other policies. There has to be backup energy for renewables. And a consideration has to be given as to who would ensure the

				<p>backup (the government, industry, or who?)</p> <p>Regulatory strategies for energy efficiency need a careful consideration as the regulation is too tight, many small and medium companies will go bankrupt.</p> <p>Carbon tax needs an integration with the Kyoto mechanisms.</p> <p>The Japanese land use policy is too ineffective. Use of the policy area for energy strategy would be very difficult in reality.</p> <p>The coordination between different government departments would be another barrier for the road map implementation.</p>
4. Do you think if a vision and policy package is desirable? Or easy to implement?	Desirable, though difficult to implement.	Desirable. The decentralised electricity sources, which characterises this vision, is also cheaper (hence, more feasible) to be developed than gas pipeline.	Regarding the priority access to the renewable energy, arguments is required as to how its cost should be shared.	<p>It is desirable in an abstract sense. But there may be too much supports for renewables. Also, the strong emphasis on regulatory approach would not be desirable.</p>
5. Do you think, for a vision and policy package, social and economical cost is large or not?	Externalities have to be appropriately reflected in the market cost.	If the financial measures are taken appropriately, the economic cost can be relatively limited.	<p>The cost for developing hybrid/fuel cells vehicles can be expensive.</p> <ul style="list-style-type: none"> • For the renewable quota + tradable green certificate system, a great care is required for the target price of the certificate. 	<p>The cost of renewable support is high, because the tight regulation would make the industry to shift their production to foreign countries.</p> <p>If ever direct current transmission becomes available, physical import of electricity can be possible. This may</p>

					lead to domestic CO2 reduction, but also undermine the Japanese industry's vitality, damaging to social stability.
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Vision III (Continued)

	Ito (Accl)	Uezono (Accl2)	Katsuta (NGO1)
1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?		It would be better to include the industrial agreement as part of national global warming actions.	
2. Do you consider the timing of option implementation is appropriate?	PRTR can be introduced much earlier.		In the road map, it is not clear how long the feed-in system continues. (It looks like the feed-in system replaced by the quota system soon after the feed-in system is introduced in 2000).
3. What would be the barriers for option implementation?	It is not clear what "fuel cells vehicle support" means. There would be strong opposition to the EPRDSA reallocation.		Transport demand management is a big issue. It is not clear where and how the hydrogen (for fuel cells) are obtained. This issue of hydrogen will affect the availability of fuel cells equipment for domestic use. This vision is weak in energy efficiency measures.
4. Do you think if a vision and policy package is desirable? Or easy to implement?			
5. Do you think, for a vision and policy package, social and economical cost is large or not?			The cost for fuel cells can become large.

Vision IV

	Utagawa (Govt)	Santoh (Ind1)	Shoda (Ind2)	Suzuki (Ind3)
1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?	<p>It is not clear what the focus of this vision. Especially, what is the relationship between local devolution and energy strategy?</p> <p>There should be more options for the ever-increasing coal share.</p> <p>More options for transport and residential sectors should be in place.</p> <p>There are two definitions of "reducing" petro-chemical products. One is to reduce the final demand for those products, other is to reduce the use of virgin materials used in the manufacture. For the time being, it would be acceptable to decrease the share of virgin materials being used. Currently, however, the recycling rate is going up, but the share of virgin materials in manufacture is also increasing. This situation is ridiculous, and has to be changed.</p>	<p>For the heat management, tax reform is more important than giving subsidy.</p>	<p>On terminology, transport demand "reduction" can be associated with restriction on mobility. It would be more appropriate to put it "transport efficiency".</p> <p>There are many other electricity storage technologies than regenerative fuel cells. Conventional battery technologies, as well as hydrogen and methanol fuel productions, should also be covered as the electricity storage technologies.</p>	<p>The vision emphasises the energy efficiency options. The vision further requires aggressive demand-side management options, as those introduced in the USA during the 80s. The effectiveness of energy efficiency may be undermined, if domestic or international emission permit trading is allowed.</p>
2. Do you consider the timing of option implementation is appropriate?		<p>Electricity price menu change can be introduced earlier than indicated.</p> <p>It is more urgent to make electricity storage technologies, than fuel cells. The electricity storage technology can be a powerful substitute for pumped water power productions.</p> <p>Electricity storage technologies have made quite advancement in</p>		<p>The priority for this vision has to be clearly on energy efficiency.</p>

		Japan, as well as in some other countries (e.g. Redox flow, NaS batteries).			
3. What would be the barriers for option implementation?	<p>On gas pipeline, there would be strong opposition from oil parliament members who have vested interest in oil industry, as well as the oil industry itself.</p> <p>Once the financial support is ready, the construction of pipeline would be possible, though the dosing business with Russia may involve some tough negotiations.</p> <p>In order for gas to be replaced with coal, tax on coal is necessary, as well as pipeline construction.</p> <p>Coal tax would meet oppositions from industry. The effect of coal tax itself may be limited, thus the combination of the tax and other options may be required.</p> <p>On the domestic CO2 permission trade, how to define initial quota would be controversial. Also, this option needs a mechanism to prevent the domestic "hot air" trading.</p> <p>Options to increase renewable share, e.g. feed in tariff and carbon tax, would meet strong opposition from industry.</p> <p>Transport demand management will meet strong oppositions from industry, although</p>	It would be difficult to get a social consensus as to the definition of "transport policy".		More argument is required on whether pipeline construction and energy efficiency can/should be pursued at the same time.	

	<p>technical improvement may come from the industry.</p> <p>Energy efficiency regulations will meet strong oppositions from industry, although technical improvement may come from the industry.</p> <p>Heat equipment subsidy may be introduced without much opposition. Much effectiveness can be expected for the solar heat utilisation.</p> <p>The definition of recycle rate has to be changed. It is better to define it as how much recycled materials being used for manufacture, rather than how many materials being recycled out of waste.</p> <p>Virgin material tax will meet opposition from industry. If introduced, immediate effect will be seen in the steel and cement industries.</p>				
4. Do you think if a vision and policy package is desirable? Or easy to implement?	Desirable.				The options specified under this vision require considerable government intervention. It may go against the currently progressing trend in Japan to make the government "small".
5. Do you think, for a vision and policy package, social economical cost is large or not?	The administrative and economic cost for this vision is not large. Social cost is undoubtedly small.	The social and economic costs are large.			It is worrying if this vision undermine economic strength and growth.

Vision IV (Continued)

1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?	Hiraishi (Cons1)	Ikuta (Cons2)	Motohashi (Cons3)	Souda (Cons4)
Land use planning is a key for the Vision IV achievement, as clever planning could significantly reduce energy demand. Development of regenerative fuel cells to store renewable electricity can be integrated into town planning.	If the options are put into practice, the achievement of targets is possible.	Heat supply strategy should be considered in line with town planning. ESCO business has a great potential to encourage household sectors to be energy efficient.	Probably sufficient. It is not clear how individual options and their effects, e.g. in terms of energy demand reduction. The strong emphasis is given to CO2 reduction, while the economic viability seems to be neglected. For the implementation of the Vision IV road map, social acceptance for economic degradation would be required.	Horizontal split of the electricity industry should be implemented earlier than identified. Electricity price menu will be changed along the line with the market liberalisation. CO2 product labelling is too early. Financial support for grid improvement should be made after the horizontal split is carried out to ensure accounting transparency. Otherwise it is like pouring money to industry without knowing how much is necessary for grid improvement. Local empowerment should be implemented earlier than identified, as already some local authorities have started its energy management (e.g. biomass production)
2. Do you consider the timing of option implementation is appropriate?	There are several options that can be introduced earlier than indicated. Especially, forest management is urgently required, as the Japanese forestry business are grossly depressed. As a result, the Japanese forests are severely deteriorated.	It is questionable if there is sufficient incentive for the household sectors to		
3. What would be the barriers for	The feed in system and gas pipeline are highly questionable to be put into			The environmental regulations can lead to further degradation of economy. It is not a

option implementation?		practice, under the current Japanese context.	take up the options indicated.	sustainable society, if the economy is slumped, even though the environmental quality improves.
		<p>Also, the forestry management needs fundamental improvement of the industry, thus it takes considerable time and efforts to be materialised.</p> <p>The revision of transport policy must aim to produce "effective" policy, rather than just being cosmetic. However, the strong transport policy would certainly met by strong oppositions.</p>		<p>CO2 permit trade and carbon tax need integration to avoid duplication of burdens.</p> <p>The financial balance needs more consideration, because if the energy demand decreases, the source of tax is also reduced.</p> <p>The vehicle tax reform would cause international trade argument.</p> <p>If the Vision IV road map implemented, industrial bases may escape to developing countries. This leads to CO2 reduction, but also undermines Japanese economy and its social stability.</p> <p>The Vision III and IV will affect the industrial structure, GDP, tax revenues. Very careful consideration should be given to take balance between environment and economy policy.</p>
4. Do you think if a vision and policy package is desirable? Or easy to implement?		The vision is desirable. There are, however, a number of options in the vision, some of which may be difficult to put into practice.	<p>It is not necessarily desirable that the government or local government make energy plans. The government's obligation may be better restricted to send key signals to the market, e.g. to increase renewable shares or energy efficiency to achieve CO2 reduction target.</p> <p>The cost to develop technology is high. It is necessary to distinguish which technologies are really necessary to be</p>	<p>Too much emphasis is given to renewables and energy efficiency. It would be very difficult to implement.</p>
5. Do you think, for a vision and policy package, social		The social and economic costs are large, as the options are holistic. The social consensus is essential before		As the industrial bases may escape to developing countries, the social and economic costs of the Vision is very high.

and economical cost is large or not?		putting these options into practice.	developed. It is not clear where the gas pipeline cost is financed from.	
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Vision IV (Continued)

	Ito (Acd1)	Uezono (Acd2)	Katsuta (NGOI)
1. Do you think the policy options are sufficient to achieve the target? If not, what policy options would you suggest to cover?	Road related budgets should be reformed, so that they can be integrated into transport demand management policy.	It would be better to include the industrial agreement as part of national global warming actions.	
2. Do you consider the timing of option implementation is appropriate?	Local empowerment should be implemented earlier, as it would take time for the policy to have any material effect. PRTR can be introduced much earlier.		
3. What would be the barriers for option implementation?	There would be strong opposition to the EPRDSA reallocation.		The vision's overall target is to "reduce the demand". It is not clear if the "demand reduction" is achieved through restrictive measures, or through a various incentives.
4. Do you think if a vision and policy package is desirable? Or easy to implement?		As it is not clear how the targets and options are linked , firm evaluation of the policy package is difficult. The target is, however, considered as the minimum requirement.	The priority in the vision has to be clearly identified as energy efficiency.
5. Do you think, for a vision and policy package, social and economical cost is large or not?			It is crucial for the achievement of this vision how the society interprets "social cost".